

APPLIED COSTING
IN SELECTED INDUSTRIES

MANUAL OF MODERN BUSINESS EQUIPMENT

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APPLIED COSTING

IN SELECTED INDUSTRIES

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Consultant on Costing Systems.

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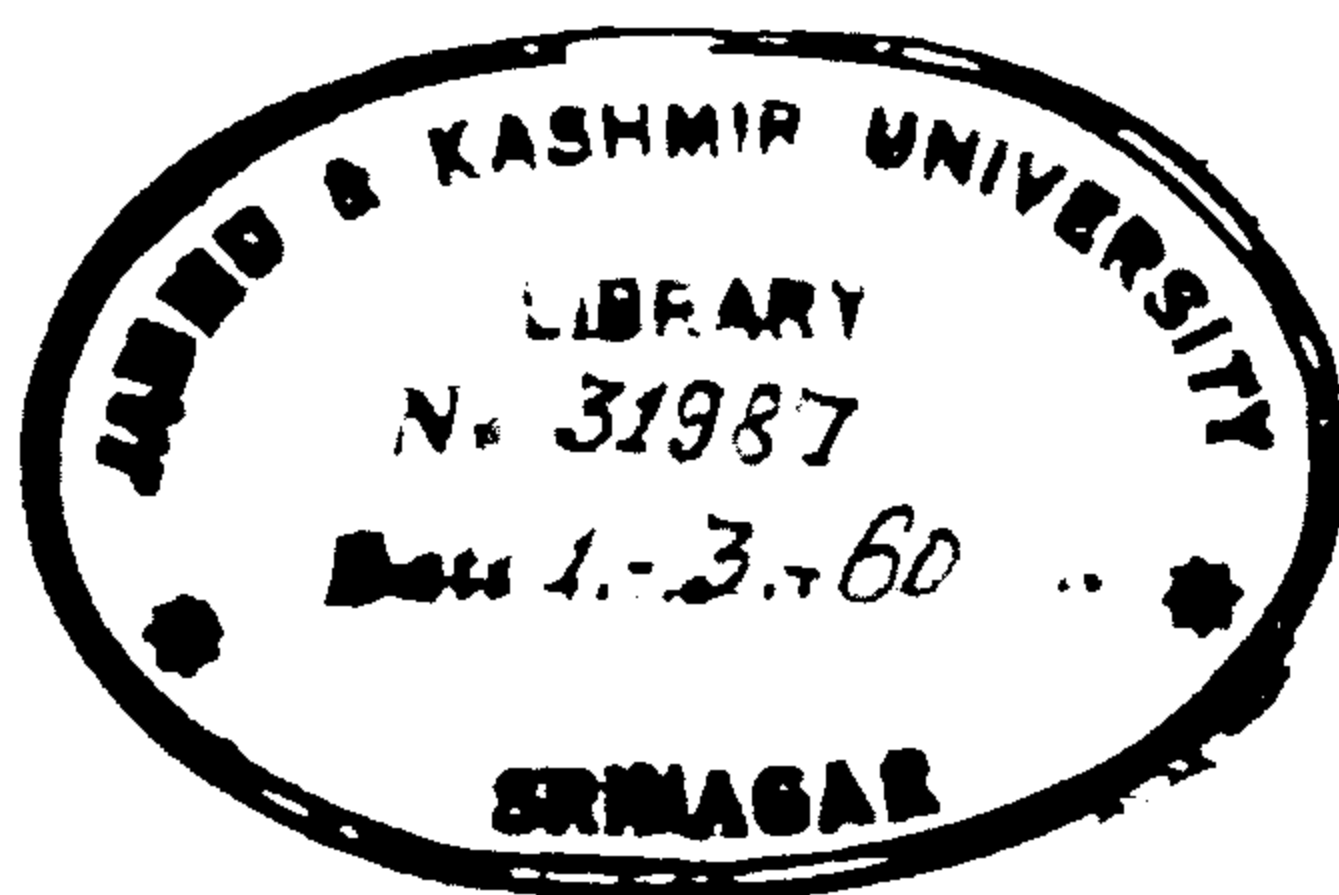
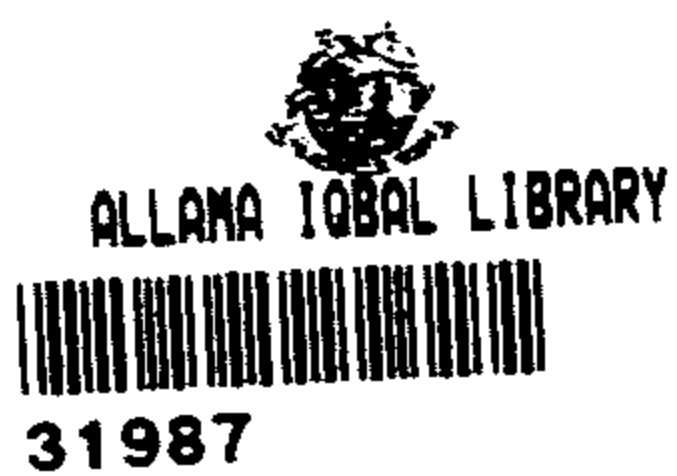
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PREFACE

1. This book, published as a companion volume to *Cost Accounting and Costing Methods*, is intended to meet the requests, which have reached me from time to time, for further illustrations of costing in industries not covered in my text-book, and, more particularly, for examples of practical cost sheets. Most text-books are based in the main on costing procedure in the engineering and allied industries, and for that reason more attention has been given in this volume to other types of undertakings, for many of which no costing information has been published hitherto. I hope to deal with other industries in another volume.

2. A cost system has to be adapted to the requirements and peculiarities of the particular industry concerned, and indeed to the organisation of each individual undertaking within that industry. It is necessary for the cost accountant to be familiar with the technical and practical side of the business if his professional objectives are to be attained. With this in mind, an endeavour has been made to enable the reader to visualise the sequences of production by introducing brief descriptions of the manufacturing procedure in the industries here examined.

3. In order to obtain the maximum number of practical examples of cost presentation in the space available, many details of costing procedure which are of general application, and which are described and discussed in *Cost Accounting and Costing Methods*, have been omitted. It will be apparent that a completely detailed description of a cost system, with reproductions of all the forms necessary for the collection and analysis of primary data for every industry illustrated, would be impracticable and undesirable for the objects in view. My aim has been to give emphasis to the more important characteristics, and a suitable form of cost sheet, whereby accountants and manufacturers may find practical indications for the method of cost finding and cost presentation. Nevertheless, I have introduced practical observations to afford guidance when considering problems of costing in undertakings which present complications. In other cases, to facilitate reference, I have indicated where further details of suitable methods, forms, and procedure may be found in *Cost Accounting and Costing Methods*.

4. The illustrations of costing in such a wide variety of industries, and the inclusion of the practical aspects of some of them have been made more representative by the collaboration of accountants of experience in costing in many of the industries selected. I am especially grateful to Mr. J. Eagling Brett, A.S.A.A.; Mr. Richard M. Elliott, A.C.A., A.C.W.A.; Mr. William Johnstone, F.C.W.A.; and Mr. A. J. Tarlton, F.C.W.A.,

who have assisted me considerably with detailed descriptions of production and costing procedure in the industries with which they have had practical experience. In addition, I acknowledge with thanks specialised information placed at my disposal by Messrs. H. Armson, A.L.A.A.; M. Asher, A.C.W.A.; J. B. Barbour, A.C.W.A.; A. V. Barker; D. Barnes, A.C.A.; and Hubert W. Pitt, F.C.A.

5. In view of the increasing interest in uniform cost systems, which may be regarded as a special aspect of applied costing, I have introduced a short chapter on the subject. My experience is that there is some tendency to confuse Uniform Costing with Standard Costing, and some doubt as to the purpose of uniform cost systems. I have discussed the latter point in the chapter referred to, but I have not included Standard Costing—i.e., the use of standard costs, as there are three illustrated chapters on the subject in *Cost Accounting and Costing Methods*.

6. For some of the industries more detailed descriptions of the costing procedure have been given, whilst for others I have found it necessary to limit details considerably, although in every case cost sheets or cost summaries which are practical have been given. In every case the *figures are fictitious*, and no attempt has been made to make them representative of current values.

7. I am aware of the limitations of this attempt to illustrate applied costing, but if it succeeds in presenting an indication of some of the methods adopted to ascertain reasonably accurate costs, and in assisting students to direct their minds to the problems involved in practical work, I shall feel that the attempt has been worth the making.

H. J. WHELDON.

London,

December, 1944.

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CHAPTER I

INTRODUCTION

The Importance of Costing.—The ascertainment of costs of manufactured commodities and services with a reasonable degree of accuracy, and in sufficient detail to afford suitable information to the management for efficient control, or for other purposes in respect of business policy and fixation of price, must be regarded as one of the essential factors of industrial progress. This is true in its national aspect as well as from the point of view of the individual business, and in the post-war period of reconstruction serious thought must be given by all executives to the part costing is to take in their planning; whether an existing costing system needs revision, or, in other cases, whether they can face their responsibilities without the aid of an adequate costing system. It is an encouraging fact that there is a rapidly increasing number of industrialists who have included a costing system in their organisation, yet there are still many who have not realised the importance and advantages of sound costing, or who fear the cost of installing and operating a costing department. Full assurance can be given to the expense economisers that if a cost system is practical, devoid of unnecessary elaboration and commensurate with the needs of the business only, it will reveal information which, if acted upon, will make the expenditure remunerative. This, not only because of economies which may be effected, but also because of the indications for the determination of a progressive and more profitable policy and control.

It is true that there has been an unprecedented increase in costing since 1939 for price-fixing purposes, owing to war-time requirements, but there is no doubt that many manufacturers, previously without adequate costing facilities, have found that cost accounting provides something more fundamental—namely, facts indicating the way to improved efficiency and elimination of factors which cause costs of production to be higher than they need be. Such information is more far-reaching than just the finding of current costs for the fixing of prices.

Each year since 1940 has witnessed more co-operation between firms in many industries for the exchange of information for the attainment of better production, with a marked tendency to formulate plans for some degree of uniformity in the manner of establishing or presenting costs. Co-incidentally stress has been laid on the benefits of some uniformity in costing in industries,

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not only by the Select Committee on National Expenditure (Fourteenth Report), and by the Nuffield College Conference Report on "Employment, Policy and Organisation of Industry after the War," but also by many Trade Associations. Further, the Institute of Cost and Works Accountants has undertaken research on the subject, and directed attention to the fundamental principles. In view of the increased interest in the subject, Chapter II of this volume has been devoted to consideration of various aspects of Uniform Cost Accounting.

Observation on Methods of Costing.—The general principles of costing are fundamentally the same for all types of industrial activity, and for all forms of costing, but the methods employed vary according to the nature of the industry and the organisation and methods of each business. It is this significant fact which gives rise to the attempt to classify costing methods in such groups as job, process, unit, operating, operation, and multiple or composite costing as defined on pages 15 to 17 of *Cost Accounting and Costing Methods*. It is, no doubt, because of the variations which occur that the requests referred to in the opening paragraph of the preface to this volume for further illustrations of costing and Cost Sheets in a number of industries have arisen.

It is desirable to refer to Marginal Costing, which provides a means of indicating the effect on costs, and consequently on profits, of variations in the volume of production. Marginal Costing is a costing method which provides for the presentation of costs of production so as to indicate the separate incidence of fixed and variable costs on varying volumes of output. In any cost system comparative figures can be, and often are, prepared which show actual cost variations. Marginal Costing is a name for prophetic costs, and may be considered as complementary to budgetary control, or as an adjunct to a Standard Cost system. From this point of view it has some managerial and price-fixing advantages in respect of policy.

Desirability of Professional Guidance.—When the introduction of a costing system is contemplated, very careful consideration must be given to an examination of the methods available, to determine which will be the most effective and economical for the purposes of the management. In this respect it must be realised that just as the methods of production necessitate the employment of, say, a skilled engineer, or a qualified chemist, so do the conception and installation of a suitable cost system necessitate the employment of a competent accountant qualified in the art and science of costing. An ill-conceived cost system may well be an unprofitable burden, and a danger to the business.

In the costing procedure described in the chapters which follow, it should not be inferred that in any particular industry

illustrated the method is the only practicable one, or that the manner of recovery of overheads is universally used in the industry. If for no other reason, such a supposition could not be maintained in view of the fact that although the routine and methods of production described are in actual use, they often vary as between manufacturers engaged in the same industry. Nevertheless they afford useful indications of how costing problems are being met, and in not a few instances difficulties have been overcome by ingenious means which have been devised by experienced cost accountants.

The Incidence of Overhead Expenses.—It will be conceded that as a general rule the ascertainment of the costs of materials and direct labour can be satisfactorily accomplished by one or other orthodox lines of procedure, although there are exceptions. The allocation and apportionment of overheads to the production departments and the most reliable means of recovering them in the costs of the various units produced present more difficult problems, and at the same time the correct solutions are of great importance. This importance has increased in magnitude with the advancement of industrial methods, which usually involve machines and plant of high capital value, so that works overhead expenses tend to exercise a greater influence on cost than wages. Dr. D. J. Garden, in his book *Flexible Budgeting and Control*,* illustrates this in the figures reproduced below, which show the changed incidence of overhead charges of two operations in the case of a well-known motor-car factory. The comparison is between the normal costs pre-1914 and in 1930.

TABLE SHOWING THE CHANGED INCIDENCE OF OVERHEAD CHARGES

Operation "A" (Turning and Boring)

	Pre-1914 Costs.	1930 Costs.
Labour	62.42 per cent.	20.48 per cent.
Overhead Charges	37.58 ,,	79.52 ,,
	<u>100.00</u> ,,	<u>100.00</u> ,,

Operation "B" (Gear-Cutting)

	Pre-1914 Costs.	1930 Costs.
Labour	61.40 per cent.	29.20 per cent.
Overhead Charges	38.60 ,,	70.80 ,,
	<u>100.00</u> ,,	<u>100.00</u> ,,

Today there are numerous examples of overheads assuming

* *Flexible Budgeting and Control*, by D. J. Garden, M.A., B.Com., Ph.D., by the same publishers, p. 9.

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even much greater proportions as compared with periods when labour, and not mechanisation, was the predominant agent of production.

This incidence of overhead expenses in a highly mechanised business is a matter which has important bearings on costs and profitability at different levels of production owing to the rigidity of fixed overheads. One effect is that in periods of declining activity costs rise rapidly, whilst prices result in even more rapidly falling profits, and at an early stage of decline losses occur when the market conditions will not permit of increased prices. In boom periods the converse is true, but usually with lesser emphasis, owing to the tendency to less vigilant control when business is brisk.

The Practical Uses of Costing.—It is largely because of this incidence that the need for efficient costing, coupled with effective use of the information which it affords, is stressed. A further advantage of scientific costing is found in its use in conjunction with budgetary control and planned production, which play so important a part in the management of highly capitalised businesses.

In conjunction with the foregoing observations it may be useful to summarise the general purposes which Cost Accounts and related statistics serve :

1. The figures recorded and summarised in the Financial Accounts are analysed and classified with reference to the cost of products and operations.

2. To arrive at the cost of production of every unit, job, operation, process, or department, and develop cost standards.

3. To indicate to the management any inefficiencies, and the extent of various forms of waste, whether of materials, time, expense, or in use of machinery, equipment, and tools.

4. To provide data for periodical Profit and Loss Accounts and Balance Sheets at such intervals as may be desired during the financial year.

5. To reveal sources of economies in production, having regard to methods, equipment, design, and output.

6. To provide actual figures of cost for comparison with estimates, and to serve as a guide for future estimates, or quotations, and to assist the management in their price-fixing policy.

7. Where Standard Costs are prepared, they show what the cost of production should be, with which the actual eventually recorded costs may be compared.

8. To present comparative cost data for different periods and various volumes of production output, and to provide guidance in the development of the business.

9. To indicate where articles or components can be bought more advantageously than made.

10. To record the relative production results of each unit of plant and machinery in use as a basis for examining its efficiency. A comparison with the performance of other types of machines may suggest the necessity for replacement.

11. To provide a perpetual inventory of stores and other materials.

12. To explain in detail the sources of profit or loss revealed in total in the Profit and Loss Account. The interlocking of the Cost and Financial Accounts is a necessary corollary for this purpose, and the costing scheme must provide for this.

In conclusion, two important aspects are worthy of emphasis, namely :

1. That costing information, to be of maximum value, must be capable of presentation with promptitude at such regularly frequent intervals as may be necessary for the purposes of the management. In some businesses this may be daily for certain aspects of activity, and in many the costs are required at intervals of a week, fortnight or four weeks. In some circumstances quarterly or longer periods are used, but such lengthy intervals result in the loss of much information which could otherwise be available for purposes of early control.

2. That effective reconciliation between the Cost and Financial Accounts should be maintained. Whether this is achieved by interlocking in one integral system of accounting, or by means of suitable Control Accounts, is immaterial, provided the necessary checks are secured to ensure that, in fact, all expenditure has been properly accounted for. No small additional advantage of the use of Control Accounts is that monthly, or other periodical Balance Sheets, Manufacturing and Profit and Loss Accounts can be prepared if desired.

CHAPTER II

UNIFORM OR STANDARDISED COSTING SYSTEMS

The Distinctive Feature of uniform systems of costing is the provision of detailed costs determined by the adoption of a standardised basis of cost analysis so that the costs revealed are properly comparable.

Two Purposes of Uniform Costing.—Distinction is necessary between (a) those uniform systems which are for the purpose of executive or supervisory control by a central authority which has power to act as may be desired upon the information afforded; (b) those designed and recommended by a trade federation or association for use by manufacturers to afford guidance in costing in a particular industry, generally without any arrangement for comparing detailed costs.

In the first class referred to the maximum degree of uniformity and action is obtained by the management of a business having a number of factories producing the same commodities; or by the executives of a company exercising control over factories owned by subsidiary or associated companies. Also in this class, although the form and degree of control are much less complete, are: (i) a public authority with powers to require submission of standard financial returns, and costs for certain aspects of control only—e.g., electricity supply; and (ii) the “Totalitarian” compulsory standardisation of accounting with a view to “directed” uniform costing in industrial and commercial groups for the purpose of State planning, as instituted in Germany.

Requirements for Uniform Costing.—Apart from the design of the form in which the resultant costs are to be presented, consideration has to be given to: (a) the headings under which items entering into cost should be grouped, (b) the scheduling of the kinds of expense to be collated under each heading; (c) the methods to be used to ascertain or apportion the costs concerned, (d) the nature of the cost and production data to be finally reported upon as a result of the costs and statistics obtained.

The points (a) and (b) are obviously essential, as without precise instruction on such matters the objective of properly comparable costs could not be achieved. In each trade the headings and schedules must be appropriately devised, and a scheme of designatory account numbers tends to accounting accuracy, and greater convenience in compilation of data.

Two such schemes of classification are illustrated on pages 107–113 of *Cost Accounting and Costing Methods*, but these are

UNIFORM OR STANDARDISED COSTING SYSTEMS 7

capable of adaptation to any industry, and of being expanded, or contracted if less detailed analysis is desirable.

Among the matters to be decided for a uniform system are :

1. The demarcation between direct and indirect labour.
2. What shall be regarded as the production centres, sections or departments for the purpose of analysis of cost.
3. What items shall be regarded as factory expense, and what shall be scheduled as administration, selling and distribution expenses.
4. What bases or factors shall be used for the apportionment and allocation of overheads to the sections in (2) above.
5. What method of recovery of factory and other overheads shall be used—*e.g.*, machine-hour rates, labour-hour rates, percentage on wages, rate per unit or other means.
6. How buying, storing, handling and issue of materials expenses shall be treated.
7. What rates of depreciation shall be charged for plant and other fixed assets.
8. If buildings are owned, what, if any, rent should be included.
9. How cost of services shall be ascertained and charged to production departments or "centres".

Further, for use of the executive, decision as to what data should be compiled and reported upon, apart from unit costs of production. For instance, it would be useful in most industries to know :

1. Quantity of output.
2. The cost per unit of production compared with the cost in previous accounting periods.
3. The ratio between wages and other expenses, probably expressed as a percentage.
4. The number of plant-hours worked, and the cost per hour, and if suitable for each centre or department.
5. The direct wage cost per working hour. This would be an average for each process or type of labour.
6. An index-number as a guide to the degree of utilisation of capacity.
7. Some facts about process losses and waste.

Special features of particular industries would need to be covered by other appropriate statistics or costs.

Uniformity Imposed by Public Authorities.—(a) When the Electricity (Supply) Act, 1926, came into operation, the Second Schedule of the Act enumerated rules for determining cost of

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production, and the undertakings concerned remodelled their accounts to facilitate the preparation of the monthly Cost Statement in the required form. A detailed description of such uniform costs is given in Chapter XXIII of *Cost Accounting and Costing Methods*.

(b) *In Germany* compulsory standardised accounting ensures uniform analysis of expenditure for accounting, by requiring collation under ten major headings for all firms. Further subdivision is laid down for firms in particular groups or trades. These requirements are for the ordinary accounts, and thus do not constitute a uniform system of costing, but they provide a basis for one. Uniform Costing Principles have been promulgated, and various "directives" have been issued for certain groups or industries, thus indicating the ultimate compulsory setting up of uniformity in costing for various industries. It is interesting to note that the Manufacturing Cost Sheet of an industrial undertaking in connection with the German plan corresponds closely with a combination of Figs. 48, 49, 50 and 52 illustrated in *Cost Accounting and Costing Methods*.

This step towards compulsory uniformity in costing enforced by the German Government has been described in detail by Dr. H. W. Singer in the fifth of the *Occasional Papers*, published by the National Institute of Economic and Social Research. This comprehensive review of German national planning of accounting and costing is worth careful study. The scheme was developed more extensively in the years preceding the war, and compulsory uniform costing is stated to have been introduced in many groups of industries. The principal objectives in war-time are, broadly, the planning of national economy; the placing of contracts rationally to the most suitable manufacturers at appropriate prices in the light of uniformly prepared costs; the fixation of subsidies, levies and pooling arrangements; and the creation of better internal management through proper accounting and costing, especially among firms which have not previously kept such records.

There is considerable evidence that much chaos and confusion have arisen, and that the vast plan is far from being effective, despite the introduction of heavy fines for wilful and inadvertent breaching of rules and rendering of inaccurate information. Nevertheless, without discussing the pros and cons of statutory compulsion, the advantages of uniform accounting and uniform costing in each industry are many, and the introduction of suitably adaptable schemes, if faithfully carried out, would tend to improve many aspects of national economy.

(c) *In the United States of America*, although the Government has stated the principles for the determination of costs under

Government contracts, and defined the elements of manufacturing costs admissible, it has made it quite clear that no particular system of accounting and no rigid formula or set procedure is required. A Treasury Decision (5000) was promulgated under Section 2 (b) of the Act of June 28th, 1940, and other provisions (sometimes referred to as the Vinson-Trammell Act) under which provision has been made for determining the allowable items of cost. Such costs are classified in logical order, but even for this outline there is no requirement that the classification shall be adopted in contractors' system of accounts, provided the information required can be furnished. A descriptive summary of the provisions is given in Chapter XXXIV.

(d) *In Great Britain* various enactments have prescribed certain accounting requirements, but not as regards uniform costing. Some declaration as to what items should be inadmissible to cost of Government contracts was made in the Colwyn Committee's Report (No. 2) published by H.M. Stationery Office, October 31st, 1918. Under the Defence of the Realm Regulations, 1939, a provision was made by Section 55AA, under which manufacturers and others may be required to keep records and accounts in any manner directed, and to allow inspection of these, but there is no general requirement for any particular method of costing.

Uniform Costing Systems Issued by Trade Associations.—The fact that a number of trade federations have found it desirable to formulate uniform costing systems appropriate to their industry demonstrates that such uniformity is regarded by astute business men as beneficial to industries.

It cannot be denied that fallacious costing, as well as non-existent costing, has caused, often unwittingly, a certain amount of destructive competition in prices. The provision of a carefully devised uniform system, reasonably complete but without burdensome complications, and formulated by cost accountants of practical experience in the industry concerned, enables those in the industry to avoid pitfalls. Once installed, there may be a saving in accounting personnel if less direct methods have been in use, and even if an increased accounting staff is found necessary, many more than compensating savings through the better efficiencies which arise from information imparted, should accrue. Small firms which cannot afford professional installation of an adequate special accounting and costing system often find the solution of their difficulty in a trade association scheme. It is known that many of the firms which have drifted into bankruptcy have done so because of their ignorance of accounts and proper costs.

The industries for which associations have issued uniform

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costing systems include: Clothing manufacture; Electrical and allied manufacture; Printing; Hosiery manufacture; Internal-combustion Engine manufacture; Iron and Steel industry; Laundries; Nuts and Bolts industry; Paper-bag making; Paper Boxes and Cartons making; Pottery-making; Paint, Colour and Varnish manufacture; Tin Box manufacture.

War-time Trade Associations.—Since the war there have been many war-time trade associations set up, and some of these have adopted a uniform method of cost presentation in view of the requirements for cost details called for by Government Departments and Controls. The fixation of maximum prices under Statutory Rules and Orders necessitates the collection of many comparative costs by the Department concerned. Frequently controlled prices are determined in consultation with trade associations, and in many cases when a permanent association has not existed a War-time Association or Federation has been formed. A committee agrees upon a standard layout of Cost Sheet, which not infrequently is approved by the Department concerned, and this is circulated to all the firms in the industry. Such action tends to encourage a common method of cost compilation, but does not ensure uniformity of cost accounting. In a number of instances, however, there is a schedule detailing what is comprised under each heading, and even a basis for allocation of overheads. It is not unlikely that this war-time co-operation may be the forerunner of the formulation of further uniform costing systems.

There is no doubt that owing to the commercial and industrial importance of accurate costing, much thought should be given to any costing scheme which is to be adopted generally by any industry to ensure that correct principles are followed, and that the most advanced methods are adopted. A fully qualified practical *cost accountant* is necessary. Since 1939 industry has certainly become more cost-minded, and in the accountancy profession the costing aspect is rightly receiving much greater attention; in fact there is a growing number of accountants specialised in costing, as evidenced by the increasing membership of the Institute of Cost and Works Accountants. These developments will, no doubt, increase rapidly in the post-war reconstruction, and indeed they must if the country is to maintain its prominent economic position amongst nations, and ensure a high standard of living.

CHAPTER III

MANUFACTURE OF DRUMS AND KEGS

DRUMS, such as those used for oils, kerosene, disinfectants, bitumen, etc., and kegs used as containers for paint, grease, putty, etc., are manufactured under mass-production methods from black-iron or terne-plate sheets of varying gauges or thickness, according to the strength necessary for the use for which the container will be required. The method of production is substantially the same, up to a point, for both classes.

The sequence of the main manufacturing operations may be summarised simply as follows :

- (i) Receiving and storing sheets of plate.
- (ii) Operations for the body of the drum or keg, viz. :
 - (a) Guillotining sheets to required size.
 - (b) Pickling, or grinding edges of plate prior to welding.
 - (c) Rolling to obtain cylindrical form.
 - (d) Spot welding side seam in position.
 - (e) Welding the side seam (or alternatively " folding " it).
 - (f) Flanging.
 - (g) Corrugating (where necessary).
- (iii) Operations for ends, viz. :
 - (a) Guillotining sheets to required size.
 - (b) Stamping circular discs for ends.
 - (c) Pressing ends to shape.
 - (d) Stamping neck hole in top end (drums only).
 - (e) Pressing or soldering neck (drums only).
 - (f) Riveting handle on top end, or lid of kegs.
- (iv) Assembling.
 - (a) Solutioning joints.
 - (b) Double seaming tops and bottoms to body (for kegs bottom only, as the lid is loose).
 - (c) Riveting lugs on keg (to support lid).
 - (d) Testing drums for air-tightness, and drying.
 - (e) Soldering leakers discovered during test.
- (v) Painting ; or varnishing inside if required.
- (vi) Drying.
- (vii) Inspection and despatch.

There may be various other operations undertaken for special

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reasons, and according to the type of drum or keg. Thus some may be wholly welded, others may require only "folded" side seams. In general, however, the above-named processes arise on the production line, and each drum passes from operator to operator in the team of workers, so balanced that the flow of production is not impeded by "bottle-necks".

Handles, lugs and other fittings are made in other departments, passed to Stores, and issued to production as required.

Sizes of drums vary from 1 gallon to 45 gallons, or occasionally more, and an even greater variety of kegs is made. The manufacturer plans to maintain a steady output of any required size by a balancing of teams.

Method of Costing.—Batch costing and unit costing are suitable for mass-production manufacturing, but there may be job costing for particular supplies.

Procedure : Raw Materials.

(i) *Black Iron or Terne-plate* sheets are stacked in a store near the commencement of the production line—i.e., close to the guillotine machine. The usual stores records are maintained for each sized sheet of the same gauge steel. Perpetual inventory records and checks are kept for the numbers and tonnage of each size. For ease of stock checking, each consignment received is allocated a "lot" number, the lots being completely used in succession.

Stocks of steel sheets tie up considerable capital, and care is necessary to ensure that balanced supplies in sizes consistent with economic cutting for bodies and ends are obtained, and controlled.

In the Stores Ledger the tonnage received figure for each lot is that as shown on the Invoice and Goods Received Note, and issues against each lot should correspond. At the end of each costing period (say four weekly) the standard weight of sheets (as used in costings) issued may be ascertained from the Ledger Account for comparison with the actual weights, to determine the adjustment of costs (based on standard weights) for average heavy or light rolling of the sheets. There is necessarily a weight tolerance for sheet rolling.

(ii) *Sundries*—e.g., necks, caps, rivets, fittings, paint, etc., are controlled with the aid of Bin Cards and Stores Ledger Accounts.

(iii) *Scrap* from the guillotine and press machines are collected, and baled for sale.

Finished Production.—After inspection, the drums are despatched almost immediately, owing to their great bulk. An

analysis of Production should be extracted by means of a code system, to provide a complete summary of each type of container produced. Such totals are used for determining the unit cost of labour and overheads as described in a later paragraph.

Labour (Direct).—The wages of each production team (including any bonus) are recorded and summarised for the costing period. The method of assessing the labour cost for each type of container produced is discussed later. It is a great advantage to have time-sheets or cards showing each employee's time on each type of drum, and the production line or department in which engaged.

A Production Bonus Scheme based on output of teams working on the production lines is particularly appropriate to this type of mass production. Suitable schemes are outlined on p. 101 of *Cost Accounting and Costing Methods*. Cost statements revealing the effective savings arising from the spread of fixed and semi-fixed overheads over increased output or conversely and from the elimination of defective work may be used with advantage.

Factory Overheads.—These are apportioned or allocated to the respective departments according to the procedure described in Chapter XI of *Cost Accounting and Costing Methods*. Methods of recovery in costs are discussed in a later paragraph.

Observations on the Cost Sheets.—Two specimen cost sheets are illustrated on pages 16 and 17, one for a 5-gallon drum, the other for a 28-lb. keg.

Cost sheets are prepared at regular intervals, commonly weekly, monthly or quarterly; one for each type produced.

The costs of materials are based on standard weights appropriate to the sizes of sheets used. Variations in cost arise only by reason of: (a) fluctuations in waste due to process defects and other items (paint, rivets, etc.); (b) changes in prices of supplies.

Minor variations may arise from rolling of sheets within tolerance limits as to thickness which affects steel weights.

Labour costs may fluctuate from (a) alterations in wage rates; (b) variations in output achieved by production teams. These may result from (i) Normal human factors which affect output, including change of workers, absenteeism, idle time, etc., (ii) Economies of any new methods, (iii) Retarding effect of introduction of new types of drums, which affects the normal production lines when labour transfers are made.

Ascertainment of Costs: (1) Materials.—(a) *Steel for Bodies and Ends.* The standard rolling weight of a sheet varies according to its gauge (i.e., thickness). The standard weights per square foot are given in the following table :—

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Standard Weights of Steel Sheets According to Gauge.

Gauge.	Lbs. per sq. ft.	Gauge.	Lbs. per sq. ft.	Gauge.	Lbs. per sq. ft.
1	14.410	11	4.540	21	1.424
2	12.840	12	4.040	22	1.275
3	11.440	13	3.600	23	1.135
4	10.200	14	3.200	24	1.010
5	9.080	15	2.850	25	0.899
6	8.080	16	2.550	26	0.800
7	7.200	17	2.270	27	0.712
8	6.410	18	2.020	28	0.637
9	5.700	19	1.795	29	0.567
10	5.100	20	1.599	30	0.502

The usual gauges are from 14 gauge to 26 gauge, according to the strength of the drums required. The Steel Rolling Mills invoice the sheets at prices per ton.

For *Bodies* the sheets are guillotined to the size required; *Ends* are stamped to size from suitable sizes of sheets. The weight as charged to the Cost Account is the standard for the gauge sheet used, and periodic adjustment is made for the rolling tolerance ascertained for the period from the Stores Ledger, and for process defects and waste. The cost is credited with rebate allowed by the steel supplier, and with proceeds from sales of scrap.

(b) *Handles, lugs, etc.*, are made and costed separately. The weight of steel used and charged to cost of these items is based on physical check, allowance being made for scrap.

Paints. The consumption for different sizes of drums and kegs is determined by tests and charged accordingly.

(c) *Reconciliation* of total charges for materials to cost with financial accounts is necessary. The total quantity of each size produced for the costing period at the value shown by the Cost Summaries is checked with the Manufacturing Account in the financial books, or passed to the Cost Ledger Control Account (four methods are described in Chapter XV of *Cost Accounting and Costing Methods*). After investigation of any differences appropriate adjustment is made in the Control Account. Any changes necessary for future costings will be made.

(2) Labour, Direct.—Various methods are used to determine the actual or apportioned charge for each type or size of container. The following methods are in operation :

(i) Detailed time sheets for each employee show the time spent on each type of drum. From the Wages Abstract (on

the lines of Fig. 58, page 161, of *Cost Accounting and Costing Method*) a summary of wages cost for the period shows the total for each type of drum, and this, divided by the output number of each type, gives the labour cost per drum.

(ii) A "Points" System, which, by means of time study of each operation, enables a given number of "points" per 100 drums of each type to be determined.

The actual production wages divided by the total points value of all quantities produced in the week, or other costing period, determines the cost value of the points. This, applied to the "points" measure per 100 drums of any size, provides the labour cost of each type in the mixed production.

(iii) Production Hour Method. The average hourly output of the production-line team is determined for each type or size, from which, by computing the team-hour wage cost, the labour cost per 100 drums of any type of drum can be ascertained.

It is necessary to reconcile total charges to cost for labour with the total direct wages paid in the costing period. Adjustment entries may be necessary, suitable to the method of presenting costs.

(3) Factory Overheads.—These are commonly resolved as a percentage on direct wages, owing to the "flow" nature of production through the production lines in the shops. To some extent this corresponds with the time element, but this method entails a small element of inaccuracy, owing to various factors. (These are discussed in Chapter XII of *Cost Accounting and Costing Methods*.) When changes occur in wage rates the percentage should be adjusted, but when such changes are frequent, this is troublesome. This can be remedied by substituting a recovery of overheads on a Unit of Output basis, which will be facilitated if the "points" method of measuring units is adopted. Many of the inaccuracies of the percentage on wages method can be avoided by a unit of output basis assessed on the points method.

(4) Administration Overheads are sometimes applied as a percentage on factory cost, but more usually as a percentage on direct labour owing to the close relationship to production in this industry.

(5) Selling Overhead.—Expenses are commonly applied as a percentage on total cost, or as a percentage on selling price. Greater refinement in the allocation of selling overheads is sometimes required, involving consideration of a varying rate of charge for each type or group of lines sold. For control purposes there may be analysis by selling areas.

(6) Distribution Overheads.—When selling prices include delivery to any destination within a defined area an average rate is

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Cost Sheet for Drum and Keg Manufacturer.

DRUMS.

Type Drum :	5-gallon D/S Black Iron Drum, Welded Side Seam.	
	26/24 gauge 50-mm. Neck, Caps complete, Painted.	
Standard Sheets used per 100 Drums :		Lbs.
Bodies :	25 Sheets Black Iron 74" × 36", 26 gauge (at 0.800 lb. per sq. ft.)	370
Tops and Bottoms :	25 Sheets Black Iron 54" × 28", 24 gauge (at 1.01 lb. per sq. ft.)	265
		635

Costs per 100 Drums. Four Weekly Period No. 10.

Material, lb.	Description.	Material Prices per Cwt.		Total for 100 Drums.			Per Drum.
		s.	d.	£	s.	d.	Pence.
370 7	Bodies—as above Add wastage 2%						
377 4	Tolerance + or – (–1% for period)						
373	Steel 26 gauge	28	6	4	14	11	
265 5	Tops and Bottoms—as above Add wastage 2%						
270 7	Tolerance + or – (+2½% for period)						
277	Steel 24 gauge	24	0	2	19	4	
650	Total weight used Less 3½% Rebate			7	14 5	3 9½	
40	Less Scrap Sales	4	0	7	8 1	5½ 5	
610	100 Necks, Caps, Wads, etc., at 18s. 6d. gross + 4% waste			7	7	0½	17-645
20	Handles	15	0		13	4½	1-602
2	Rivets	36	0		2	8	0-320
	Paint—2 gallons at 8s. 6d. per gall.				7½		0-078
	Solder				17	0	2-040
					4½		0-045
632	(Av. per Drum 6.32 lb.)				9	1 1	21-730
Labour—1000 units at 0.575 d. per unit					2	7 11	5-750
Prime Cost					11	9 0	27-480
Factory and Administration Overhead Expenses—at 160% on Labour					3	16 8	9-200
Total Production Cost					15	5 8	36-680
Selling Expenses—5% on Total Production Cost						15 4	1-840
Total Ex Works Cost					16	1 0	38-520

Cost Sheet for Drum and Keg Manufacturer.

KEGS.

Type Keg : 9½" × 16½" Black Iron Keg, D/S, Welded Side Seam.			
26/24 gauge, Flat Handle, Varnished Inside, Painted.			
Standard Sheets Used per 100 Kegs :			Lbs.
Bodies : 25 Sheets Black Iron 60" × 35", 26 gauge (at 0.800 lb. per sq. ft.)			292
Tops and Bottoms : 25 Sheets Black Iron 44" × 22", 24 gauge (at 1.01 lb. per sq. ft.)			170
			462

Cost per 100 Kegs.

Four Weekly Period No. 6.

Material, lb.	Description.	Materials Prices per cwt.		Total per 100 Kegs.			Per Keg.
		s.	d.	£	s.	d.	Pence
292 6	Bodies—as above Add wastage 2%						
298 6	Tolerance + or - (-2% for month)						
292	Steel 26 gauge	28	6	3	14	3½	
170 3	Tops and Bottoms—as above Add wastage 2%						
173 3	Tolerance + or - (+2% for month)						
176	Steel 24 gauge	24	0	1	17	8½	
468	Total weight used Less 3½% Rebate			5	12 4	0½ 2½	
44	Less Scrap Sales	4	0	5	7 1	9½ 6½	
424 16 20 4	Lugs on Lid Handles Rivets Paint—1 gallon at 12s. 6d. per gall. Varnish—½ gallon at 9s. per gall.	24 24 36	0 0 0	5	6 3 4 12 4	3 5 3½ 3½ 6 6	12.756 0.410 0.515 0.155 1.500 0.540
464	(Av. per Keg 4.64 lbs.)				6	12 3	15.870
Labour—750 units at 0.575 per unit					1	15 11½	4.312
Prime Cost					8	8 2½	20.182
Factory and Administration Overhead Expenses—at 160% on Labour					2	17 6	6.900
Total Production Cost					11	5 8½	27.082
Selling Expenses—3% on Total Production Cost						6 9½	0.813
Advertising—2% on ditto						4 6	0.540
Total Ex Works Cost					11	16 11½	28.435

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computed from the total cost of road and rail transport, including own delivery department costs, using the tonnage dispatched in the period as divisor. By use of ratios for sizes, or by tonnage of each size dispatched, the average delivery cost for each type can be determined.

Reconciliation with Financial Accounts.—This is facilitated if one of the various methods of Double-Entry Control Accounts, or the tabular analysis described in Chapter XV of *Cost Accounting and Costing Methods*, is adopted.

Another useful statement is a Cost and Sales Analysis Summary prepared for each costing period, whereby profit or losses by types are shown, and reconciled with the results shown by the corresponding total profit or loss in the financial accounts. This may be done quarterly, but it is more useful if effected monthly.

CHAPTER IV

MANUFACTURE OF JAMS AND PRESERVES

JAMS and preserves are made from sugar, fruit and setting compounds in the form of natural pectin and citric acid. In the season fresh fruit is used. Surplus fruit is preserved as pulp in barrels to be manufactured later. In this way an otherwise seasonal production is levelled out over the year.

Fresh fruit is purchased from the growers direct or through markets or agents, and is utilised as soon as possible after receipt, as loss through mildew and mould is rapid, especially with soft fruits, such as raspberries, blackberries, strawberries, etc. Any stalks, strigs, stones, etc., will be removed by hand or machine, whichever is more suitable.

The prepared fruit is mixed with sugar, water and pectin in accordance with the recipe prepared by the chemist to correspond with the standard it is desired to market. The quantity mixed per "pan" or per "boiler" will depend on the machinery and plant available. The sugar and water may be added to the fruit, or a sugar syrup may be prepared separately.

The mixture is boiled for the period necessary to produce the prescribed fruit and/or sugar content of the out-turn. This will be determined by weight, temperature, and/or special scientific instruments designed to disclose the soluble solid content. The jam is transferred in mobile containers to tables for filling by hand or to hoppers for machine filling. Any scum is removed and reconstituted into sugar syrup, or added to the next boil.

The filled jars or cans are washed, labelled and ultimately packed into cartons or cases, the procedure being similar to other canned or bottled commodities.

Method of Costing.—The most suitable method of costing is a combination of process and unit costing. There are three distinct processes :

- (i) Preparation of fruit or pulp.
- (ii) Making the jam.
- (iii) Filling into jars, etc., packing and finishing.

The most suitable unit of cost is weight, the usual ones being cwt., lbs., dozen lbs., or gross lbs.

It is preferable, however, to have two units : (1) unit of jam—*e.g.*, per cwt. of jam to the stage where it is ready for filling into containers, (2) unit of pack—*e.g.*, per fibreboard carton of 36×1 -lb. jars in display carton, per wooden crate of 24×2 -lb. jars or cans for export, etc.

Fresh Fruit Control Book.

Department : Preparation. Type of Fruit : Strawberry.									
Day.	MONDAY.		TUESDAY.		WEDNESDAY.		Total for week ending		
	Weight, lbs.	% on Weight to Jam Dept.	Weight, lbs.	% on Weight to Jam Dept.	Weight, lbs.	% on Weight to Jam Dept.	Weight, lbs.	% on Weight to Jam Dept.	
Total Invoice Weight . . .	3014	1.1	2699	0.4	4643	3.0	19,734	1.5	
Loss in Transit . . .	30		10		123		270		
Received Weight . . .	2984	5.7	2689	7.0	4420	0.1	19,464	0.5	
Plugging Loss . . .	160		175		249		1,170		
Bad Fruit . . .	2824	0.5	2514	0.1	4171	2.0	18,294	1.3	
	14		2		81		240		
Transfers to Pulp . . .	2810	—	2512	0.5	4090	—	18,054	0.3	
Weight to Jam-making Dept. .	2810	7.3	2500	8.0	4090	11.1	18,000	9.0	
Invoice Value . . .	£ s. d.								
Price per cwt. invoiced . . .	75 7 0								
Price per cwt. to Jam Dept. .	50s. 00s. 1d.								
Remarks . . .			Large quantity of small and unripe fruit. Refs. J. A. B. D. E. F.		High percentage of loss in transit and bad fruit due to very over-ripe fruit. Refs. D. E. F.				

Procedure.

Materials.—(a) Fruit is perishable hence control of quantities received, and of the losses in the various stages of production is important (a suitable form is given on page 20). Adequate records are necessary in respect of products, residuals and wastages, which consist of :

(i) *Loss in Transit* due to drip, fruit going mouldy and pilferage. The drip loss applies to soft fruits—*e.g.*, raspberries, strawberries, blackberries, etc.—especially if very ripe. The loss is the discrepancy between invoice weights and received weights. The possibility of claims has to be investigated.

(ii) *Inspection Losses* on picking over are due to unripe, over-ripe and mouldy fruit. In some cases unripe and over-ripe fruit—*e.g.*, strawberries—can be used in other jams.

Similarly, fruit unsuitable for fresh-fruit jam may be satisfactory for putting down as pulp. Rejected fruit can only be disposed of as waste or manure.

(iii) *Waste of Inedible Parts* attached to fruit. The loss arises in the following operations :

- (a) Plugging strawberries.
- (b) Strigging blackcurrants.
- (c) Snibbing gooseberries.
- (d) Stoning plums.

Where the jam is to be made from fresh or whole fruit these operations will be carried out by hand. Where the fruit is pulped, however, the stalks, strigs, etc., can be removed more easily by machines.

Losses in the processing of the jam include :

(iv) *Loss by evaporation in boiling.* This loss will vary between different fruits and the same fruit in different seasons. Detailed statistics will be recorded by the laboratory. The extent of this loss is primarily dependent on the period for which it is desired to keep the jam, and whether for home or export trade, etc.

(v) *Filling Loss.* A certain amount of jam is spilt in filling jars or tins, and some will adhere to the sides of the boilers, pans and other utensils.

(vi) *Over-filling.* In order to ensure that, for example, a 1-lb. jar does actually contain 1 lb., it is necessary to over-fill slightly. This allowance must be watched and checked from batch to batch.

Daily Report of Consumption of Ingredients and Details of Output.

Date.	Number of "Bolls."	Pulp Used, lbs.	Fresh Fruit Used, lbs.	Sugar, lbs.	Pectin, lbs.	Water, lbs.	Other Ingredients.			Weight of Oil, lbs.	Scum, lbs.	Weight of Filled Containers per Schedule, lbs.	Loss in Overfilling.	
							 lbs.	 lbs.	 lbs.				lbs.	%.
October 7 .	10	551	—	720	—	100	—	—	—	1110	10	1090	10	0.9
8 .	10	566	—	721	29	100	—	—	—	1119	9	1099	11	1.0
9 .	7	526	—	607	28	70	—	—	—	771	8	752	11	1.5

Variety: Plum.

Daily Analysis of Quantities and Weights Packed.

Date: October 7th.

Variety.	Containers Filled.										Packed into Cartons.				Stacked.			
	1-lb. Jars.		2-lb. Jars.		7-lb. Jars.		2-lb. Tins.		Broken or Damaged.		Total Weight.		1-lb. Jars.		2-lb. Jars.		7-lb. Jars.	
	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.
	754	754			48	336					48	336						
Plum and Plum Apple	109	109	450	900														
Raspberry and Plum.			201	402	50	350												
Total	953	953	651	1302	98	686						2941						

(vii) *Testers*. There will be the usual loss due to opening occasional jars for testing as to consistency, sugar content, etc.

There normally will be no necessity to maintain stores records as such, as the fruit must be used or pulped as quickly as possible. The longer it is kept the more rapidly will it go bad, with correspondingly increased costs.

(b) **Fruit Pulp**.—The fruit is pulped by putting the fresh fruit into barrels and adding water and a small quantity of sulphur dioxide. Strawberries, for example, can be put down in June and used for jam-making during the following winter. Careful records must be kept of quantities of fruit so preserved, register numbers of barrels, etc.

When making jam from this pulp the added water will have to be allowed for in the recipe—*e.g.*, 100 lbs. pulp equals 90 lbs. fresh fruit. It can be either weighed out or measured when preparing ingredients for each boil.

(c) **Sugar, Pectin, Acid, etc.**—There are no abnormal losses of these, and the stores records for them follow the lines outlined in *Cost Accounting and Costing Methods*, Chapters IV and V.

(d) **Credits**.—Due credit must be taken in the costs for the sale of any items of scrap, etc. Examples are bad fruit, packing-cases (where not returnable) and sugar bags.

(e) **Daily Report on Consumption**.—A suitable form is given on page 22.

Materials—Packing.—These include jars, bottles, tins, cases, cartons, labels, wire and tape. The records for the receipt, store and issue of these follow the normal procedure.

Independent records of containers issued, filled and packed will disclose the number and percentage damaged or broken on the filling line.

Labour.—The direct labour costs will normally fall under the following headings :

(a) *Fresh Fruit—Preparation*. This will include receiving, inspecting, plugging, strigging, etc., as applicable. The total labour so expended will be allocated to each crop as a direct charge.

(b) *Fruit Pulp—Preparation*. Except in special circumstances, the hand labour involved in preparation of fresh fruit will not be concerned. There will be the labour of putting down into barrels, coopering, etc., supplemented by the machine cost of extracting plugs, strigs, etc. The total labour will be spread over the total weight put down.

(c) *Jam-making*. This will cover weighing out ingredients, attending boiling-pans, testing, etc.

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(d) *Filling and Packing.* The following operations are usually undertaken by teams of girls each with a charge hand :

- (a) Filling into tins or jars, previously heated.
- (b) Inserting waxed disc.
- (c) Closing tin or capping jar.
- (d) Washing and drying.
- (e) Labelling.
- (f) Packing into cartons.
- (g) Strapping, wiring and labelling cartons.
- (h) Stacking.

The type of " pack " will vary—*e.g.*, 1-lb., 2-lb. or 7-lb. containers packed in wood cases and/or cardboard display cartons, etc.

(e) *Indirect.* This will include such items as trucking, general cleaning.

Although wages are usually paid by hourly rates, a system of payment by piece work may be introduced into the fruit preparation and the filling and packing departments. There is also the team system of remuneration. Incentives to speed up production may be introduced.

(f) *Records of Wages, Output, and Weights Packed.* The foreman will make a daily return of labour hours and output for each filling unit. A weekly abstract is made summarising the labour cost of filling and packing. These forms are given on page 25.

A daily analysis of quantities and weights packed of each variety of jam is necessary. It is used for entering up the Stock Ledger. A convenient form is given on page 22.

Works Overheads.—Analysis allocation and recovery of overheads will proceed on the lines indicated in *Cost Accounting and Costing Methods*, Chapters IX to XI. Having allocated overheads to departments, unit rates of recovery by operations can be employed, viz. :

- (i) Preparation—per cwt. of fruit prepared.
- (ii) Pulp yard—per cwt. of fruit pulped; or per cwt. of pulp.
(There is about 10% greater weight of pulp owing to added water.)
- (iii) Jam floor—per cwt. of jam made.
- (iv) Filling and packing—per unit of pack.

Where it is not desired to analyse the incidence of overheads to this extent, the best method of recovery is by weight—*i.e.*, per cwt. of jam produced.

Daily Return of Labour Hours and Output per Filling Unit.

Filling Unit : No. 2.
Jam : Pulp.

Name.	Hours.		Variety.	Filled.				Packed.			Stacked		
	Ord.	O/time.		1-lb.	2-lb.	7-lb.	Breaks.	1-lb.	2-lb.	7-lb.	1-lb.	2-lb.	7-lb.
Brown, A. .	8		Plum	720		80		720					
Smith, B. .	8		Plum and Apple			70		720		40			
Jones, G. J. .	8		Raspberry and Plum	864				1584			144		40
Roberts, F. .	4		Blackberry and Plum.	1584									70
Charles, D. .	8	‡											
Arnold, F. .	4												
Weight equivalent				3168		150		3024		40	144		110
				lbs. 3168	lbs. —	lbs. 1050	lbs. —						
Breaks, etc.				Total pans received 38 = 4256 lbs.									
				Total weight filled 4218 "									
				Overfilling and waste 38 " = 0.9%.									
				Signed : A. Brown. Forewoman.									
				Signed : J. Fletcher. Jam Foreman.									

Weekly Wages Abstract—Jam Filling and Packing Dept.

Pulp Jams.

Variety.		Plum.	Plum and Apple.	Raspberry and Plum.	Blackberry and Plum.	Blackberry and Apple.	
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
October	week ending :						
	7						
	14						
	21						
November	28						
	4						
	11						

Cost Sheet: Fresh Fruit Jam—Strawberry.

Season : 1942.
Schedule : 7.

Process I. FRUIT PREPARATION DEPT.				Process II. JAM-MAKING DEPT.				7B	
7A									
	Sub- sidiary Sched- ule.	Total Weight 1942, lbs.	Percentage on Weight to Jam- making Dept.		Sub- sidiary Sched- ule.	Total Weight 1942, lbs.	Total Cost.	Cost per cwt. of Jam Made.	
			1942.					1941.	1942.
Total Invoice Weight	.	110,400							
Loss in Transit	.	1,500	1.5		7A	100,000	£ s. d.	s. d.	
Received Weight	.	108,900				2,560	0 0	11 6	
Plugging Loss	.	6,500	6.5			850,000	0 0	32 8	
	.					20,000	0 0	3 9	
Bad Fruit	.	102,400	2.0			50,000	—	—	
	.	2,000							
Transfers to Pulp, etc.	.	100,400	0.4			520,000	10,700 0 0	47 11	
	.	400				5,000	0 0	5	
Weight to Jam-making Dept.	.	100,000	10.4			515,000	10,610 0 0	47 6	
	.					15,000			
Invoice Value	.	£2560							
Price per cwt. Invoiced	.	51s. 11d.							
Price per cwt. to Jam-making Dept.	.	57s. 4d.				500,000	10,610 0 0	47 6	
	.								
	.						700 0 0	3 2	
	.						150 0 0	8	
	.						60 0 0	3	
	.						200 0 0	11	
	.						11,720 0 0	52 6	

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Production Records.—Statistics (preferably summarised daily) are required in addition to those of losses and wastages, in respect of the following :

- (i) Number of batches or “boils”.
- (ii) Weight of fruit, sugar and other ingredients used. Although kept independently, these should tally with (i), after allowing for wastage.
- (iii) Weights of “boils” when completed.
- (iv) Number of containers filled (physical check and/or machine counted).
- (v) Number of containers packed (physical check) if packed immediately.

Normal stock records will be kept of receipts and issues of the finished article.

Cost Sheet.—A Cost Sheet is required for each kind of jam made and filled. If a weekly Cost Sheet is prepared it will be necessary to complete a summary for the “Season” for each kind of fresh-fruit jam.

In the specimen for strawberry jam given on pages 26 and 27, the Cost Sheet is in three sections, corresponding to the three main manufacturing processes.

CHAPTER V

CANNING OF FRUIT AND VEGETABLES

IN a factory engaged in canning fruits and vegetables, prompt processing is essential, and the organisation for production and costing differs considerably from that of most industries.

Factory Procedure may be summarised as follows :

- (a) Receiving and handling the fruit and vegetables.
- (b) Receiving and storing cans, labels and cases.
- (c) Preparation of produce for canning—*e.g.*, (i) Rumbling, peeling or scraping (potatoes or roots); (ii) Washing or soaking (peas, beans); (iii) Grading, cleaning, top and tailing (carrots, etc.); (iv) Sorting waste; (v) Stoning of fruits; (vi) Dicing, slicing, etc. (carrots); (vii) Inspection.
- (d) Blanching vegetables where necessary.
- (e) Filling into cans with addition of water, syrup or brine.
- (f) Exhausting, seaming cans and cooking.
- (g) Cooling and stacking.
- (h) Labelling cans and packing in cases.
- (i) Despatch.

The Processes are continuous, and often under mass-production methods, whilst standard sizes of cans and cases are used. Inspection tests are necessary at regular intervals at points in the production stream. In the stacking period losses through “blown cans” arise.

Preliminary storage of fruit and vegetables is avoided as much as possible, by regulating the deliveries and passing the produce immediately to the preparation department.

The canning operations proceed in a steady flow through the canning line. Operatives are supplied with the prepared produce, and cans are filled, usually by hand, and set off on a moving band. Weight is checked, water, brine, sauce or syrup is added, and the filled cans slowly pass through the cooking stage. This may be a retort or bath of boiling water, and the rate of movement and temperature is regulated according to the produce. The lid is fitted by a sealing machine. The sealed cans roll down to the labelling department, and thence to the packing department, whence the finished supplies are transferred to the finished stock store.

It should be mentioned that some fruits are canned in syrup prepared with sugar and water; vegetables in brine prepared with salt and water; and beans sometimes in a tomato sauce.

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After transference of canned produce to the finished stock store a subsequent inspection is necessary to eliminate "blown" cans. Such losses, involving contents, cans, labels, labour and overheads, have to be assessed for inclusion in costs.

Method of Costing.—Unit Output Costing is usually adopted, but Batch Costing may also be used. The most convenient unit of cost is a gross of cans, even though selling prices are normally "per dozen", as the use of the "dozen" unit results in expressing costs as decimals of a penny, which is unsatisfactory.

Costing Procedure.—A useful Cost Sheet is given on page 34. A similar summary is prepared for each type and size of can filled. In addition, comparative schedules in columnar form may be prepared for: (a) Successive weekly costs when the same production extends over several weeks, (b) Corresponding period in the previous season, (c) Cumulative average costs for the current season.

It is sometimes the practice to extend the Cost Sheet to show the profit or loss margin and selling value.

Materials.—Stores procedure normally adopted for more durable materials cannot be applied to the same extent to fruits and vegetables of a perishable nature. A running record, described in a later paragraph, is kept, and is based on standard Goods Received Notes, which are also used for checking invoices. For the purpose of charging supplies put into production in each weekly costing period, delivered perishable materials not yet processed can be ascertained physically, so that the cost and weight passed into production can be determined. In the case of peas which are usually bought in large quantities from farmers, already threshed, the deliveries are "picked", dressed, etc., by special plant or by hand. The stores records of these usually show for each lot number the weight received, weight of pickings, and weight issued to the soaking tanks. These matters are dealt with in Chapter XXXI devoted to pea and bean canning.

Carrots, potatoes, beet, etc., are purchased by the cwt. in sacks; dried peas in cwts. or quarters; fruit in hampers, bags, chips, etc.

Weight Processed, and Losses in Process. The fruit or vegetables are filled into cans of standard sizes, so that for each size of a given product the total net weight filled can be calculated from the number of cans recorded by the automatic counter on the canning lines, or by a physical count in the case of small canneries having no automatic lines of plant. This, deducted from the original gross weight of (say) plums, reveals the process loss. The weight or percentage loss is recorded at regular intervals daily or weekly, as it is an important factor of cost. Causes of losses are: (a) Soil; (b) Tops, tails, eyes, stones, stalks, etc.; (c)

Peeling, rumbling, scraping; (d) Bad, pest-damaged or spoiled produce; (e) Moisture loss; (f) Overfilling; (g) Contents of cans withdrawn for testing, or of "blown" cans.

In the case of dried peas or beans there is a gain in weight, equivalent to about 90%, due to soaking for canning (see Chapter XXXI).

Other Supplies, such as cans, cases, labels, adhesives; and non-perishable ingredients (sugar, colour, salt, etc.), should be subject to usual stores records and control, as should finished stocks.

Bags, baskets, boxes, barrels, etc., whether charged separately or in the price of the produce, may be returnable or saleable, and should be subject to stores control.

Methods for stores records and control are described in Chapter V of *Cost Accounting and Costing Methods*.

Cost of Materials.—In the busy season for fruits and vegetables the deliveries are so frequent that it is desirable to keep a Register or running record for each kind of produce, ruled to provide the following information: (a) Date of receipt; (b) Supplier; (c) Weight received as per Goods Received Note; (d) Reference number of the Goods Received Note; (e) Invoice number, date, price per cwt., value; (f) Carriage Inwards charged; (g) Bags (or other containers) supplied; (h) Bags or containers returned.

In each costing period (whether for a batch, week or for total production of short-season fruit, etc.) the totals of weights and values in columns (c), (e) and (f) give the weight and delivered value of the produce used.

In appropriate cases where stocks can be carried forward adjustment for opening and closing stocks for the costing period can be made.

Syrup and Brine.—The cost can be computed each week from the issues of sugar and salt as per Stores Requisition Notes. When more than one type of canning proceeds simultaneously, the quantity appropriate to each is charged out at the ascertained cost. Alternatively, a standard syrup and brine cost for each kind of produce and size of can may be used, adjustments being made should the price of sugar or salt change. Physical check at the end of each week is desirable to verify accuracy of consumption charged to costs.

Direct Labour.—Most operations are of general application, and the wages paid for the work can be charged to each operation by giving standing order numbers, whereby totals for each period are obtained by analysis on Wages Abstracts. This procedure calls for time-sheets or time-clocks. Suitable forms and details of methods are described in Chapter XII of *Cost Accounting and Costing Methods*.

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The teams on the actual canning line of operations can be recorded for the time a particular commodity in a given size of can is passing through the canning line.

From the various records so made unit rates of charge for labour can be established in various ways, of which the following are examples :

<i>Operation.</i>	<i>Method of Recovery of Cost.</i>
Unloading cans.	Rate per gross of cans handled.
Produce handling.	Rate per cwt. (or ton).
Preparation for canning.	Rate per cwt. (or ton), a separate rate for each kind of produce.
Soaking (peas and beans).	Rate per ton soaked.
Canning line.	See following paragraph.

The wages for the canning-line team determined for each production order divided by the number of gross produced gives a cost per gross. The same should be done for the hours occupied when overheads are recovered on a production-hour basis.

It will be seen that this costing procedure can be applied to obtain the labour cost for any commodity in a particular size of can.

Alternatively, to avoid the use of Time Sheets, a ratio or "points" system may be used. A size of can which is commonly used is selected as a standard for (say) a vegetable, for which the time per gross required by the canning line team is determined by test. Variations in this standard time are calculated for other sizes of can, and for other varieties of produce canned ; for these, ratio factors or points values are established, by the use of which the apportionment of each week's wages can be made if there has been a variety of cannings.

Indirect Labour in the factory should be analysed according to usage and included in the appropriate heading of Factory Overhead. Such labour includes handymen, mechanics and engineers, boilermen, departmental foremen, cleaners, watchmen, canteen workers, timekeepers, etc.

Factory Overhead Expenses.—Budgets should be prepared of fixed and fluctuating expenses, and duly apportioned to factory departments. In the departments where cleaning, preparing and other handling work takes place with manual labour, labour-hour rates may be set up. For the filling, cooking and other canning-line operations a plant-hour rate or rates should be calculated. This is necessary because some produce needs a longer period of cooking and retorting, and time is also a variable factor for different sizes of cans for certain parts of the processing. For some operations the incidence of overheads is constant

irrespective of product or size of can. For others overheads will be directly proportionate to size, so that an A2½ can with a 30-oz. filled weight would require a 50% higher overhead charge than an A2 can with a capacity of 20 oz. If a size is adopted as a standard, the rate for other sizes can be computed by applying a predetermined scale of ratios. The same principle can be applied to Steam Costs, which are best applied by a separate series of rates, owing to the magnitude of the item, and the varying incidence of usage, which is not parallel with the incidence of other production overheads affecting the canning line.

Some canners avoid these refinements and recover overheads as a percentage on direct labour, or as a production-hour rate.

Small canners with a single canning line ascertain the weekly or daily cost of factory overheads, and charge any particular run of a product, with the proportionate amount for the number of days or weeks involved.

A further alternative is calculation of a "points" value for a selected standard, increasing the "points" charge on a technical estimate basis to allow for size of can, time of cook, steam usage and other variable features. Each production order passing through the plant is then charged according to the number of "points" assessed.

Administration overheads are applied usually as a percentage on factory cost.

Selling and Distribution are recovered as a percentage on total cost or selling price. Delivery costs vary according to method of pack, size and weight, type of container, nature of transport and distance. The charges to cost will depend upon policy and circumstances.

A Daily Production Register is advisable in which may be recorded daily readings of the automatic counters on each canning line or of the physical count of production where no automatic counters are installed. This enables losses or gains at each stage to be determined.

Reconciliation between the produce received for canning and the finished canned output should be effected at frequent intervals.

Records must be maintained of "blown" cans. As the weekly cost statement will be completed before the number of blown cans can be known, an estimated average, based on experience, has to be used in the costs. The continuous record kept enables periodic adjustment of the charge to be made.

The Finished Stock Ledger Accounts are debited with the quantity of filled cans for each line of fruit, vegetables, etc. Any blown cans discovered must be credited, and debited to a Blown Cans Loss Account. If the amounts charged on an estimated

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Cost Sheet for Fruit or Vegetable Canning.

WEEKLY COST SUMMARY

Product..... Size Can : A2½
Production cans. Net Filled Weight per Can.....ozs.
Cost Period No.....

Raw Materials Con- sumed, cwts.	Details.	Total Value.			Per Gross Cans.	
		£	s.	d.	s.	d.
	Fruit or Vegetable used at..... per cwt.					
	Carriage Inwards					
	Allowance for Bags					
	Net Loss—waste and overfilling% (on weight used)					
	Net Filled Weight of Production					
	Syrup/Salt					
	Colouring					
	Less Sale of Residuals					
	Materials Cost					
Supplies	Cans (A2½ Plain) at per gross plus% waste					
	Cases (Fibreboard/Wood) at per 1000 plus.....% waste					
	Labels at per 1000 plus% waste					
	Wire, Adhesives, etc.					
	Materials and Supplies Cost £ s. d.					
Labour	Handling Cans and Raw Mater- ials					
	Preparation					
	Cannery					
	Labelling and Packing					
	Despatch					
	Prime Cost					
Factory Overhead Expenses	Fluctuating					
	Fixed					
	Factory Cost					
	Administration Overhead Expenses (.....% on Factory Cost)					
	Distribution Overhead and Delivery Selling and Advertising (.....% on Factory Cost)					
	Total Cost					

basis to costs are credited, a check on the reasonable accuracy of the charge is obtained.

Line or Graph Charts of production, process losses, and costs are useful for progress and managerial control purposes, particularly for lines regularly in production.¹

¹ Suitable charts are described and illustrated in *Business Statistics and Statistical Method* (by the author, and the same publisher), in particular progress charts (page 50), and special feature graphs such as fig. 42, page 66; fig. 76, page 131; or fig. 101, page 185, which is suitable for adaptation.

CHAPTER VI

CANNING OF BLACK CURRANTS FOR VITAMINISED PURÉE

BLACK currants, which are rich in vitamin C, are canned during the fruit season, so that they may be converted by manufacturing chemists into vitaminised purée.

As with most soft fruits, there is a loss in weight during transportation, and in the preparation for canning the removal of bad fruit, leaves, stalks, strigs and grit results in further weight loss.

Owing to the need for preserving the maximum amount of vitamin C, the fruit and juice must not come in contact with copper, and special pans and fittings made of stainless steel or plated metal have to be used.

Method of Costing.—As the season is short, the whole season's pack can be costed by the Job or Terminal Costing method, the season's production being regarded as the "job". The costing may be dealt with also by batches to obtain a batch cost. In view of the continuity of canning this single product, Unit Output Costing can be adopted, a cost being completed weekly or at the end of the short season.

Procedure.—The general routine will follow that already described for Canned Fruits. A specimen Cost Sheet is given on page 38, and the reference letters in the first column are for the purpose of referring to subsidiary books and reports in which the detailed information shown in total in the Cost Sheet may be found.

It is desirable that the details of the items A to L should be collated batch by batch to ensure a constant check on weights, losses, out-turn, etc. The wastage (item D) includes bad fruit, leaves, stalks, strigs and grit. The particulars of production summarised at the top of the Cost Sheet are useful records for the management.

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COST SUMMARY			Schedule No.		F/2	
Season's Production of			Season		19...	
CANNED BLACK CURRANTS			Fruit		Black currants	
for subsequent conversion into			Total wt. Fruit Recd.		tons	
Vitaminised Purée			Total wt. Fruit Canned		tons	
			Total wt. Canned		tons	
			Total cans filled		gross	
			Average weight per can		oz.	
			Average wt. fruit per can		oz.	

Schedule.	Cwts.		Total Cost.			Cost per Gross Cans.	
			£	s.	d.	s.	d.
A	—	<i>Black Currants</i>					
		Total weight invoiced (at per ton)			—		
		Add charge for containers, or use of			—		
		Add commission, where paid			—		
		Add carriage inwards			—		
AA		Total cost of weight invoiced			—		
B	—	Less loss in transit (equals% of A)					
C	—	Total weight received					
D	—	Less waste in picking over (equals% of C)					
E	—	Total weight available after picking over					
F	—	Less weight not suitable for canning, and therefore pulped in SO ₂ in barrels			—		
G	—	Total weight available for canning for purée			—		
H	—	Water added as water and steam					
J	—	Weight after processing (.....% of G)					
K	—	Weight as packed					
L	—	Waste in filling, overfilling, etc. (equals% of K)					
		<i>Packing Supplies</i>					
M	—	Cans at per gross (including wasted = % of no. used)			—		—
N	—	Labels at per 1000			—		—
O	—	Cartons at per 1000			—		—
P	—	Tape at per 1000 ft.			—		—
Q		Labour. Receive, pick over, process, fill, exhaust, close, label, pack, despatch			—		—
R		Factory Overheads as allocated			—		—
S		Factory Cost			—		—
T		Administrative Overheads, ...% on S			—		—
U		Cost of Production			—		—
W		Selling Expenses as allocated			—		—
X		Cost of Sales			—		—
Y		Delivery Charges			—		—
Z		Cost of Delivered Sales			—		—

CHAPTER VII

MANUFACTURED DRUGS AND ALLIED PRODUCTS

THE manufacture of pharmaceutical chemicals, drugs, vitamins and allied products involves, as a rule, various chemical processes, and in some cases the further process of compressing by machines into tablet form.

There are three special aspects of manufacturing these products which have to be considered :

(i) The necessity for vital precision as to the nature, quantity and quantitative analysis of ingredients used. This calls for a highly meticulous series of controls for materials, and special arrangements for those which are scheduled by statute as "Dangerous Drugs". The quantitative controls must extend beyond the receipt and issue of materials into the various processes at every stage where formula specification needs to be verified. Apart from cost, and the prestige of the manufacturer for his product, tragic results might follow error in the use of poisons.

(ii) Some materials used for catalytic action are largely recoverable, and others, like nitric acid, hydrochloric acid and silver nitrate, are recovered in a less pure form, and can be re-refined or used for other purposes. In other cases large residues arise due to chemical changes. It is possible even to have residuals in greater quantity than the original ingredients introduced.

(iii) Processes often result in the production of intermediate products, which may be used in one or more subsequent processes, or even for incorporation in the manufacture of another product. Consequently intermediate Stock Accounts have to be maintained to show the quantity made and its disposal.

The final packing is usually an important element of cost. Liquids which are sold in small containers may be packed in small bottles, tubes or ampoules, which themselves may require cartons and protective materials. Powders may be in paper packets, small cardboard boxes, ampoules, or bottles, and may be loose in these containers, or compressed into tablets or gelatine coverings.

The Method of Costing is usually Process Costing, but in the case of a specialised single product Unit Costing is also used. The unit of cost may vary from process to process, and from product to product, and may be weight or volume.

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Procedure.—(a) *Materials.* Main Stores are operated on the usual lines, using bin cards and Stores Ledger records and controls, but owing to the great accuracy required, checks and counter-checks are provided on receipts and issues by an efficient technical staff. In the various sections of the process plant the materials come under the control of the chemists. It is a common practice for a special register of receipts and usage to be entered up by the chemists in charge, showing quantities only; intermediate products made for incorporation in subsequent processes are often similarly recorded in this chemists' record. With the aid of this, the Cost Department can make the necessary abstracts and evaluations for each cost period. Some process sequences are protracted, and the cost period may be four weeks or longer, but if such conditions do not obtain it is sometimes convenient to adopt weekly or fortnightly periods. Owing to the complexity of names of many materials, it is usually necessary to use a carefully devised code to facilitate references in the stores and cost records.

(b) *Labour.* In the process plants the workers' time is recorded by time-sheets, or other means as to the process on which occupied. It is usual to give each process a code letter or number, to simplify the records. In the filling and finishing departments the times spent on each operation and product are recorded. This facilitates the analysis of wages to operations and products, and in addition it enables works overheads to be applied by a labour-hour rate, or, if more suitable, by a shop-hour rate. The information is also useful for ascertaining the labour cost of refining or otherwise treating "recovered" materials which may arise at different processes.

(c) *Overhead Expenses* of Plant and Laboratories (Special and General) in connection with process work require careful allocation. They are better applied separately from the other Works Overheads connected with filling and finishing. The depreciation and obsolescence of highly specialised plant, and maintenance requires particular care. A complete schedule of all items is desirable, with columns for the allocation of each item to the respective process "centres". A plant register is essential.

The methods and factors to be taken into account are detailed in Chapters IX to XII of *Cost Accounting and Costing Methods*.

It is usually most equitable to recover by Process-hour, Laboratory-hour and Machine-hour rates, although for some types of chemical manufacturing in which a labour force is used in each section it is not unusual to use a Labour-hour rate. In some processes there is very little labour, and a Process-hour rate is more reliable, especially as the major labour charge is for the operative chemists and technical managers of the plant.

Glassware, and parts liable to corrosion or other chemical action, are usually charged on a renewals basis in the plant overheads. It is also usual to make provision for short-period obsolescence for plant liable to rapid deterioration, or to adaptation necessitated by changes due to technical developments and new discoveries emanating from the Research Laboratory.

Auxiliary services often play an important part. The provision of steam, electricity and other process heat; large-scale production of distilled water; vacuum plant; and compressed air are examples. In the filling and finishing departments special plant may be used for sterilising ampoules and bottles, bottle-washing and sealing. Complex tube-filling machines for pastes, ointments, etc.; bottle-filling and sealing machines and various forms of tablet compressing machines are often involved.

All these subsidiary processes and services are separately costed and charged to processes or products, according to incidence.

The Valuation of By-Products and Residuals is often not a simple matter. The initial materials may be solids, liquids or even gases, as may the resultant products.

Usually a quantitative weight or volume may be used as the basis of apportionment of cost of the main product and by-products in which the manufacturer trades. Credit is given to processes for the value of residuals which are sold as such, at the price obtained, or at the net receipt value after debiting any costs of treatment or refining. In some cases the residual can be refined or re-concentrated for subsequent use, in which case the reconstituted quantity re-used can be credited at the original cost. Alternatively, it is sometimes the practice to ascertain the cost of refinement and debit the subsequent period with the quantity used at this value. This is less accurate, but over a succession of periods the effect is nearly the same, and the method is convenient.

Another method is to base the apportionment of net cost on the yields in percentage form calculated by the works chemists. This is useful when by-products are subsequently realised at high values.

Illustration.—The diversity of products in this industry makes choice difficult for illustration, and the specimen Cost Sheets given are adapted to illustrate the costing of the production of an imaginary vitamin, its bottling and conversion into tablets. Although largely self-explanatory, the accounts should be considered in the light of the observations which follow.

The costs relate to the extraction of the refined vitamin in six processes, bottling in liquid form, and tableting. The first three accounts refer to the processing of three crude oils to obtain

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three products (say fictitiously Pep 1, Pep 2, and Pep 3). Account IV deals with the emulsification of these three chemicals, which process produces crude vitamin extract. Account V shows the cost of primary purification for commercial grade; Account VI gives the cost of the final refining of the finished Vitamin Pep. The remaining accounts, VII, VIII, IX and X, deal respectively with Bottling the refined liquid; Casking of Commercial Vitamin Pep; Casking of Crude Vitamin Pep; and tabletting of Refined Vitamin Pep.

Materials Recovered. The appropriate process must be credited with these at current values less cost of recovery and disposal.

In Process I, 28 lbs. of hydrochloric acid in crude form are recovered from an input of 56 lbs. crude and 35 lbs. pure.

In Process II, 84 lbs. of nitric acid, pure, are introduced and 14 lbs. of nitric acid, crude, are recovered.

In Process III, 28 lbs. of copper sulphate are introduced and 56 lbs. of copper sulphide are recovered. At the same time 140 lbs. hydrochloric acid, pure, result in a recovery of 28 lbs. crude.

By-Products. In Processes I, II and III the by-products are here called Oilene A, B and C. They are in important quantities, and are evaluated according to technical reports and market tendencies and credited at those prices.

Wastage and Process Losses consist of dross and useless residuals, evaporation, scum and spillage. The dross is given a net disposal value of 2s. cwt.—i.e., 3s. 6d. cwt. sale value, less cost of labour and containers.

Code References. Each batch is given a reference code number, which follows through to the final process or operation. Any error can be traced back to actual production, so that any faulty batch can be destroyed, or reworked if possible. In rare cases when a fault is discovered subsequent to delivery the code would enable the deliveries to be identified and recalled. For some products a permanent code reference is arranged for each plant (or laboratory) and process, and these are used as a prefix to the serial batch or order numbers. Thus in Process I. Lab. Order No. B. 1. 535 means Laboratory B, Process I, batch No. 535. All bottles or containers of this production will bear the reference B.1/535.

Overhead Expenses. Many expenses are capable of being a direct charge to particular processes. Other laboratory overheads are charged at suitable predetermined rates for each laboratory or plant. When there is not a continuous, even flow through the processes, it is necessary to compute and use a rate for each process.

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In the illustration, the overheads in Accounts I to VI are based on a rate "per laboratory-hour"; in Account VII as a percentage on labour; and in Account X as a machine-hour rate.

Stores Voucher Numbers. For printing convenience these have been inserted only in Process I Account. The prefix letters refer to the five sub-stores, except that when preceded by "R" the item is a return to the store concerned. As the main products, by-products and waste pass to separate locations, the Stores Inward Vouchers, numbered serially, also bear a code letter for each location.

Cost Sheets. The Cost Sheets are prepared for each cost period. Those illustrated have been simplified by the omission of some detail, but they are otherwise representative, and sufficiently complete to enable the cumulative cost to be followed through the various processes.

It should be observed that whilst some products require only two or three processes, it is not uncommon, in the case of complex commodities, for ten to twenty or even more processes to be considered and costed.

Tabletting.—The Cost Sheet records a check on the formula content of the tabletting ingredients. It is usual, and necessary, for reconciliation to be effected between :—

1. The theoretical out-turn per batch.
2. The number of tablets made as indicated by the mechanical recorders.
3. The actual numbers packed, by machine or by hand, into containers.

The difference between items 2 and 3 is represented by tablets which are dirty, contaminated, broken or crushed. Some of these are suitable for "job lines", and others are collected and re-worked.

The difference between items 1 and 2 arises chiefly from the cumulative slight spillage in the hopper or flow into the compressing mould. Some of this "dust" can be recovered and passed into the re-worked material.

Process Account X in the illustration shows the details of costs.

A separate chapter on the manufacture of tabletted chemicals will be found on page 171.

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Process I.

PROCESSING OF CRUDE OILS YIELDING PEP I

Lab. Order No. : B.1. 535 Order 500 lbs. Pep I Cost Period No. :

	Content Material, lbs.	Auxiliary Material, lbs.	S.V. No.	Price.	Unit.	Value.
<i>Debit.</i>						
Crude Liver Oil X	560		X/123	60/-	lb.	1680 0 0
Petroleum Oil	35		X/124	12/-	gall.	2 2 0
Paraffin, Refined	300		X/125	2/6	gall.	3 15 0
Potash	1400		Y/237	10/-	cwt.	6 5 0
Hydrochloric Acid, Crude .	56		Z/432	20/-	cwt.	10 0 0
Do. Pure	35		Z/433	40/-	cwt.	12 6 0
Ice		448	Q/4481	5/4	cwt.	1 1 4
Salt		140	P/985	5/-	cwt.	6 3 0
Sulphur Dioxide		112	Z/434	40/-	cwt.	2 0 0
.....						
Labour						70 0 0
Laboratory Overheads 245 hours at 20/- per Laboratory hour						245 0 0
	2386					£2011 12 1
<i>Credit.</i>						
Recoveries : Hydrochloric Acid, Crude	28		RZ/72	20/-	cwt.	5 0 0
Sulphur Di- oxide		56	RZ/73	40/-	cwt.	1 0 0
Waste : Dross, etc. . . .	1344		W/5627	2/-	cwt.	1 4 0
Products : "Oilene A" . .	212		OA/742	3/11	lb.	41 10 4
Pep I	502		PI/456	3/18/5	lb.	1967 12 9
	2086					2011 12 1
Evaporation Loss, etc. .	300					
	2386					£2011 12 1

Process II.

PROCESSING OF CRUDE OILS YIELDING PEP II

Lab. Order No. : C.2. 742 Order 200 lbs. Pep II Cost Period No. :

	Content Material, lbs.	Auxiliary Material, lbs.	S.V. No.	Price.	Unit.	Value.
<i>Debit.</i>						
Crude Liver Oil Y	700			45/-	lb.	1575 0 0
Petroleum Oil	100			12/-	gall.	6 0 0
Paraffin, Pure	25			2/6	gall.	6 3 0
Lime	56			10/-	cwt.	5 0 0
Nitric Acid, Pure	84			50/-	cwt.	1 17 6
Sodium Bicarbonate . . .	28			20/-	cwt.	5 0 0
Salt		112		5/-	cwt.	5 0 0
Ice		560		5/4	cwt.	1 6 8
.....						53 1 8
Labour						
Laboratory Overheads 148½ hours at 25/- per Laboratory hour						185 15 0
	993					1824 2 1
<i>Credit.</i>						
Recoveries : Nitric Acid, Crude	14			24/-	cwt.	3 0 0
Sodium Nitrate	7			73/-	cwt.	4 7 0
Waste : Dross, etc. . . .	70			2/-	cwt.	1 3 0
Products : "Oilene B" . .	75			17/2	lb.	64 7 6
Pep II	205			8/11/8	lb.	1759 5 9
	371					1824 2 1
Evaporation Loss, etc. .	622					
	993					£1824 2 1

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Process III.

PROCESSING OF CRUDE OILS YIELDING PEP III

Lab. Order No. : D.3. 844 Order 75 lbs. Pep III Cost Period No. :

	Content Material, lbs.	Auxiliary Material, lbs.	S.V. No.	Price.	Unit.	Value.
<i>Debit.</i>						
Crude Liver Oil Z	800			20/-	lb.	800 0 0
Petroleum Oil	120			12/-	gall.	7 4 0
Caustic Potash	560			10/-	cwt.	2 10 0
Hydrochloric Acid, Pure	140			40/-	cwt.	2 10 0
Copper Sulphate	28			76/-	cwt.	19 0
Ice		896		5/4	cwt.	2 2 8
Salt		224		5/-	cwt.	10 0
.....						
Labour						270 3 6
Laboratory Overheads 727 hours at 26/- per Laboratory hour						945 2 0
	1648					2031 1 2
<i>Credit.</i>						
Recoveries : Copper Sul- phide	56			96/-	cwt.	2 8 0
Hydrochloric Acid, Crude	28			20/-	cwt.	5 0
Waste : Dross, etc.	550			2/-	cwt.	9 10
Products : "Oilene C"	150			1/17/4	lb.	280 0 0
Pep III	78			22/8/2	lb.	1747 18 4
	862					2031 1 2
Evaporation Loss, etc.	786					
	1648					2031 1 2

Process IV.

EMULSIFICATION OF PEPS I, II AND III TO YIELD CRUDE VITAMIN PEP

Lab. Order No. : F.4. 213 Order 100 lbs. Crude Vitamin Pep Cost Period No. :

	Content Material, lbs.	Auxiliary Material, lbs.	S.V. No.	Price.	Unit.	Value.
<i>Debit.</i>						
Pep I ex B/1/535	300			3/18/5	lb.	1176 5 0
Pep II ex C/2/742	150			8/11/8	lb.	1287 10 0
Pep III ex D/3/844	50			22/8/2	lb.	1120 8 4
Distilled Water	1000			1d.	gall.	8 4
Hydrochloric Acid, Pure	28			40/-	cwt.	10 0
Charcoal	56			80/-	cwt.	2 0 0
Electricity		1200 units		1½d.	unit	7 10 0
Carbon Dioxide		896 lbs.		50/-	cwt.	20 0 0
Ice		50 cwt.		5/4	cwt.	13 6 8
Salt		5 cwt.		5/-	cwt.	1 5 0
.....						
Labour						76 5 0
Laboratory Overheads 140 hours at 40/- per Laboratory hour						280 0 0
	1584					3985 8 4
<i>Credit.</i>						
Recovery : Hydrochloric Acid, Crude	7			20/-	cwt.	1 3
Waste : Dross, etc.	73			2/-	cwt.	1 4
Product : Crude Vitamin Pep	100½			39/13/1	lb.	3985 5 9
Evaporation Loss, etc.	1403½					
	1584					£3985 8 4

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Process V.

PURIFICATION TO YIELD COMMERCIAL VITAMIN PEP

Lab. Order No. : G.5. 379 Order 60 lbs. Commercial Vitamin Pep Cost Period No. :

	Content Material, lbs.	Auxiliary Material, lbs.	S.V. No.	Price.	Unit.	Value.
<i>Debit.</i>						
Crude Vitamin Pep ex						
F/4/213	90			39/13/1	lb.	3568 17 6
Distilled Water	150			1d.	gall.	1 3
Charcoal	28			80/-	cwt.	1 0 0
Electricity		1800 units		1½d.	unit	11 5 0
Ice		50 cwt.		5/4	cwt.	13 6 8
Salt		5 cwt.		5/-	cwt.	1 5 0
.....						
Labour						53 2 11
Laboratory Overheads						
98 hours at 35/- per						
Laboratory hour						171 10 0
	268					3820 8 4
<i>Credit.</i>						
Waste : Dross, etc.	31			2/-	cwt.	7
Product : Commercial Vita-						
min Pep	59½			47/10/11	lb.	2829 0 8
Crude Vitamin						
Pep	25			39/13/1	lb.	991 7 1
Evaporation Loss, etc.	152½					
	268					£3820 8 4

Process VI.

PURIFICATION TO YIELD REFINED VITAMIN PEP

Lab. Order No. : H.6. 876 Order 15 lbs. Refined Vitamin Pep Cost Period No. :

	Content Material, lbs.	Auxiliary Material, lbs.	S.V. No.	Price.	Unit.	Value.
<i>Debit.</i>						
Commercial Vitamin Pep ex						
G/5/379	20			47/10/11	lb.	950 18 4
Distilled Water	35			1d.	gall.	4
Charcoal	14			80/-	cwt.	10 0
Electricity		2000 units		1½d.	unit	12 10 0
" Altimol "	5			125/-	lb.	31 5 0
Ice		10 cwt.		5/4	cwt.	2 13 4
Salt		1 cwt.		5/-	cwt.	5 0
.....						
Labour						37 2 1
Laboratory Overheads						
45 hours at 41/- per						
Laboratory hour						92 5 0
	74					1127 9 1
<i>Credit.</i>						
Waste : Dross, etc.	15.00			2/-	cwt.	3
Product : Refined Vitamin						
Pep	14.75			60/6/5	lb.	889 14 3
Commercial Vita-						
min Pep	5.00			47/10/11	lb.	237 14 7
Evaporation Loss, etc.	39.25					
	74					1127 9 1

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Process VII.

BOTTLING REFINED VITAMIN PEP IN LIQUID FORM

Cost Period No. :

Qty.		Amount.			Per 1-lb. Bottle.		
		£	s.	d.	£	s.	d.
	Refined Vitamin Pep				60	6	5
	Bottles, 1 lb., complete					3	0
	Case, specially fitted					4	3
	Labels, shavings, etc.						6
	Filling Labour						3
	Filling Overheads—100% Labour						8
	Packing Labour						4
	Packing Overheads—50% Labour						
	Packed Works Cost				60	15	8

The accounts VIII and IX relating to casking the Commercial Vitamin Pep and Crude Vitamin Pep will both be similar in form to Process VII Account.

Process X.

TABLETTING OF REFINED VITAMIN PEP

Tab. Order No. : N/18/14231

Order 100,000 tablets

Cost Period No. :

Formula, grammes per Tablet.		Weight per Standard Batch of 50,000 Tablets, lbs.	Weight, lbs.	S.V. No.	Price.	Unit.	Value.
0-004977	Vitamin Pep Refined ex H/6/876	5	10		£60/6/5	lb.	603 4 2
0-022395	Starch	22½	45		20/-	cwt.	8 0
0-007465	Sugar	7½	15		50/-	cwt.	6 8
0-049766	Powdered Milk	50	100		112/-	cwt.	5 0 0
0-000995	Sodium Bicarbonate	1	2		2/-	lb.	4 0
	Distilled Water	10	20		1d.	gall.	2
	Labour						2 3 5
	Departmental Overheads 10 hours at 12/6 per machine hour						6 5 0
							617 11 5
	Less 980 tablets reworked at £6 per 1000 (standard)						5 17 7
							£611 13 10
OUT-TURN							
	Nominal (50,000 per standard batch)		100,000				
	Number ex machine		99,576		= 6¼/- per 1000.		
	Decrease on Nominal		424		= 0.424 % on nominal.		
	Number packed		98,500		= 6¼/2 per 1000 packed naked.		
	Loss in packing		1,076		= 1.081 % on number ex machine.		
	Loss in packing re-Tabletting		980		= 91 % on total packing loss.		

The packing costs for the tablets will be similar to those indicated at schedule VII. They will vary with the type of pack, viz. : tin, tube or bottle; size of container; whether for direct retail or wholesale trade, etc

CHAPTER VIII

THE PRODUCTION OF SALT

THE production of salt (sodium chloride) for domestic and commercial use may be by the "Open-Pan" method, or the more modern Vacuum Process. The latter results in pure salt in a fine crystalline form. It is this characteristic which gives such salt its "free-running" quality, although some forms of vacuum-made salt need a small admixture of phosphate or other material to ensure it. The Open-Pan method is chiefly used for salt in block form, known in the trade as "Lumps", fine powdered "Dairy Salt" and cruder commercial qualities in bags or truck loads.

The Open-Pan Method.—Brine is pumped from the earth into large pans constructed of steel plates. These vessels are at least 20 ft. square (sometimes longer) and 18 in. deep. Underneath one end of the pan are furnaces with flues conveying heat below the length of the pan. The brine boils, thus concentrating the solution, and during this process impurities settle on the bottom, whilst the salt moves away from the furnace end of the pan, in the form of flakes in suspension near the bottom. There is also a crust of salt which forms along the edges of the "pans".

Workmen with long ladles lift the salt sludge into a set of wooden box-drainers (about 2 ft. 6 in. by 9 in. sq.), which are stood on a ledge along the sides of the pan. The water drains off, leaving blocks of salt in the familiar form. If required in smaller blocks, cutting is done with circular saws after stoving, *i.e.*, drying.

The offcuts and powdered salt resulting from the saws, together with broken blocks, and, if required, whole blocks, are milled into the powdered form known as dairy salt.

Common or coarse salt to be sold loose or in bags is not drained in box-drainers, but scooped out on to wooden floors. The water drains off, and the salt is then wheeled off in trucks and tipped through hoppers to the warehouse floor below, for packing into sacks, etc.

All salt to be sold in blocks, or as dairy salt, is carted to heated pits and platforms, where it dries and drains.

The Vacuum Process. Brine is pumped from the earth and passes into cylindrical mixing-pans, receiving chemical treatment to remove impurities. The purified brine is collected into large storage tanks, ready for processing. It is pumped into the vacuum plant, where it passes through many small tubes, and, owing to being heated in vacuum, boils at low temperature, thus effecting concentration. Use is made of the fact that diminishing pressure

regulated by the degree of vacuum in the successive tanks causes the brine to boil at lower temperatures. As the process continues, the concentrated brine passes into another part of the plant, where the crystallised particles fall through a heated tube to the collector. A continuous bucket elevator carries the damp salt to a dehydration plant consisting of a large rotating steel drum through which a heated air current passes. This is *Stoved Vacuum Salt*. Part of the moist salt is also merely dried by a rotating gauze cylinder, and may be sold so dried as *Unstoved Vacuum Salt*; or may go through the stoving plant. As the salt emerges it is scraped off mechanically on to a belt conveyor, and passes to a heated hopper. The hopper may be designed to grade the salt. This, or subsidiary hoppers, feed the salt into sacks, or to smaller feed-hoppers which permit filling of small packets.

The plant has to be drained at frequent intervals every week for washing; and after a certain period the plant is down for a few days for cleaning out the tubes of the vacuum chambers. It should be mentioned that the high capital cost and maintenance charges connected with the vacuum plant demands a large output for economical production. This modern process produces salt at a lower cost than the open-pan method.

Method of Costing.—Unit output costing is suitable, and the Cost Sheet will be sectionalised to show the unit cost of brine-pumping, salt concentration, stoving and packing. The unit of cost is a ton of salt.

Costing Procedure.—The brine cost consists of mineral rights and subsidence contributions, fuel, power, labour and repairs and maintenance of the pumping plant. In the open-pan method furnace fuel is an important factor, and consumption in each cost period must be recorded. The labour cost of skimming and ladling the salt sludge into box-drainers, and of removing caked sediments on the steel bottom of the tanks, are obtained by usual methods, e.g., time sheets.

In the vacuum method the costs are segregated in five process accounts: brine cost, purification, vacuum process, dehydration, packing.

A Cost Sheet summary for bagged vacuum salt is given on page 52. Separate Cost Sheets are prepared for packeted salt.

In the case of block and dairy salt the purification process does not arise. The cost of milling has to be included in the Cost Sheet for Dairy Salt.

Overhead Expenses. The general factory expenses are apportioned to the respective departments. It is usually convenient to budget the annual amount and reduce to a charge per costing period. Alternatively, a ton rate is assessed. Periodic check is maintained by means of Control Accounts, and any necessary

adjustments are made. Fuel and power are charged at actual. Land subsidence occurs occasionally and Overheads may include a charge spread over long periods to cover subsidence claims.

As there is but a single product up to the point of packing, the throughput enables costs to be resolved into costs per ton.

The labour cost of packing may be recorded on Time Sheets to ascertain the cost of sawing salt blocks to size ; filling other salt into sacks ; wrapping or filling into packets and cartons. In the case of sacks, stitching and branding have to be charged.

For detailed considerations of methods of apportioning and allocating overheads see Chapters IX to XII of *Cost Accounting and Costing Methods*.

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Cost Sheet for Salt in Bags.

Produced by the Vacuum Process.

Production : 2049 tons.

Cost period : 10.

Do. Previous Period : 1967 tons.

	Cost per Ton.				
	Period 10.		Period 9.		
	£	s.	d.	pence.	pence.
Brine Cost :					
Wages	5	19	6	0.70	0.83
Fuel and Power	25	0	3	2.93	2.75
Maintenance	17	6	7	2.03	3.17
Other Overheads	38	8	4	4.50	5.10
	86	14	8	10.16	11.85
Purification :					
Wages	52	8	5	6.14	6.95
Chemicals	394	10	4	46.21	46.34
Power	16	11	3	1.94	2.19
Maintenance	14	8	6	1.69	1.94
Other Overheads	112	13	10	13.20	14.64
Disposal of Sludge	4	17	4	0.57	0.63
	682	4	4	79.91	84.54
Vacuum Plant :					
Wages	175	3	9	20.52	23.17
Fuel and Power	695	2	5	81.42	85.72
Maintenance, Plant	503	4	0	58.94	64.73
Overheads	478	2	0	56.00	61.70
	2533	16	6	296.79	319.86
Dehydration (Stoving) :					
Wages	67	2	1	7.86	8.12
Power and Fuel	133	17	4	15.68	16.32
Overheads	96	9	6	11.30	12.41
	2831	5	5	331.63	356.71
Bagging :					
Bags	1980	14	0	232.00	232.00
Wages, Filling	123	5	7	14.44	14.76
„ Stitching and Marking	72	11	4	8.50	8.50
Overhead Expenses	39	5	6	4.60	5.10
	5047	1	10	591.17	617.07
Administration Overhead	293	18	0	34.42	37.85
Distribution Overheads :					
Loading, Dispatch, Wages	81	3	10	9.51	9.73
Wagon Hire and Freight Charges	2086	1	0	244.34	231.49
	£7508	4	8	879.44	896.14

Note: A large amount of vacuum salt is sold unstored, in which case the costs of the stoving process are omitted.

CHAPTER IX

MANUFACTURE OF PROCESSED CHEESE

PROCESSED cheese is bulk cheese which is broken down, mixed with certain emulsifying ingredients, and changed into a semi-creamy state by cooking. The resultant cheese may be sold commercially in fairly large blocks to grocers, or wrapped in small portions of various shapes and packed in small boxes or cartons for retail sale.

Many kinds of cheese may be used, as for instance Canadian, American, New Zealand and varieties produced in the United Kingdom. They are kept in cold store for a period, and issued for manufacture as required.

The cheeses are stripped of the outside rind, and any impurities are removed. The stripped cheese is then broken up and placed in large kettles for boiling, certain emulsifying salts being added. The cooked mixture is moulded into the familiar triangular or other shape and wrapped in tin-foil. The large oblong blocks from which grocers sell by weight are cut off to the appropriate bulk, and are also wrapped in tin-foil.

There is a resultant moisture gain in weight of processed cheese over the original weight of raw cheese and salts introduced into the process. This is usually termed "over-run" in the trade.

Method of Costing.—Process Costing may be used, but unit Output Costing up to the stage of emulsification, combined with batch costing for subsequent operations, is suitable.

Procedure.—*Materials.* A stores record is kept of the issues of cheese and salts, each item being priced according to the cost shown in the Stores Ledger. The weight of ingredients passed into production is recorded and reported daily. The weight of rinds and other abstractions prior to passing to the cooking kettles is also recorded daily, together with the weight of processed cheese resulting. In the wrapping department the weight of wastage of tin-foil is reported, and all foil waste is collected for sale. The sums received for these rinds and wastages are credited to costs.

The requisite containers (cardboard packets, cartons or tins, as the case may be) are issued in bulk, and returns of usage reported daily.

Labour. The direct labour charge is facilitated by sectional pay-rolls for : (a) stripping and preparing, (b) cooking, (c) packing and finishing. If there is varied packing involved, it will be necessary to introduce Time Sheets or Cards in order that an

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abstract of analysis by kinds may be prepared to obtain the appropriate charge for each production order concerned.

Factory Overhead Expenses. When only one type of processed cheese is produced, the factory overheads may be recovered as a rate per lb. or per cwt. of cheese produced. This will usually apply for the preparation and processing. When the form of packing varies (e.g., blocks and small boxes of sections of cheese), the overheads should be departmentalised, and separate unit rates calculated.

Cost Sheet.—Processed Cheese.

TYPE "A" IN 1-LB TINS (50 PER CASE).

Cost Period

Production 58,000 lb.

Stage.	Lb.	Item.	Total.						Cost per 100 lb.	
			£	s.	d.	£	s.	d.	s.	d.
1. Prepare.	50,036	Canadian Cheese at 93s. 2d. cwt.	2081	2	0					
		Handling Charges, ½%	10	8	0					
2. Cook.		Labour—Stripping and Preparing	2091	10	0					
		Departmental Overheads (100% Labour)	12	10	0					
			12	10	0	2116	10	0	73	0
		Labour—Cooking and Pipe-lines	4	10	0					
		Departmental Overheads (200% Labour)	9	0	0					
	2,692	Emulsifying Salts	23	0	0	36	10	0	1	3
	52,728									
	5,272	Over-run—10%.								
	58,000	Out-turn.				2153	0	0	74	3
3. Pack.	58,000	Tins at 25s. per 100	725	0	0					
		+ 1% waste	7	5	0					
			732	5	0					
	504	Tinfoil at £22 cwt.	99	0	0					
		Credit waste	9	0	0					
			90	0	0					
	1,160	Cases (Wood) at								
		3s. 6d. ea.	203	0	0					
		+ ½% waste	10	0						
			203	10	0					
4. Administration.		Sundries (Stencil, Wire, etc.)	20	0	0					
		Labour	36	0	0					
		Departmental Overheads (200% Labour)	72	0	0	1153	15	0	39	9
						3306	15	0	114	0
5. Selling.		Factory Cost								
		Administrative Overheads (5% Fac. Cost)				165	6	9	5	9
						3472	1	9	119	9
		Selling and Distribution Expenses				173	12	1	6	0
		TOTAL COST				£3645	13	10	125	9

CHAPTER X

COCOA MANUFACTURE

THE primary operations are the cleaning, roasting and winnowing of the beans, and a loss in weight arises from dust and shell in the winnowing, in addition to evaporation, etc., in roasting. The roasted beans are ground, and pressed into cocoa cake, a considerable weight of the cocoa-butter content being extracted. This butter, incidentally, is an important ingredient of chocolate.

The value to be placed upon the cocoa-butter extracted is a matter for careful consideration, as these factors influence the final cost of cocoa as well as chocolate.

The cocoa cake is later broken down to powder, and sieved. Any flavours required are incorporated. The cocoa powder is then filled into tins. There are further small process losses in these operations.

Method of Costing.—Process Costing is appropriate, the unit of cost at each process being 1 cwt., although for convenience of calculations a unit of 100 lbs. may be used, as mentioned on page 60.

Procedure.—It is convenient to divide each year into a number of equal periods (*e.g.*, weeks or a fortnight) for costing purposes, each period being given a distinguishing number. The practice of numbering such costing periods saves time, and space in the many Record Sheets and Accounts, and its usage is increasing in this country.

Materials.—As in most forms of process costing, careful records of materials passed into production, and resulting output at each process, is necessary to establish process losses and the unit cost of output. Losses may be shown as a percentage, and comparative figures are useful for control purposes.

In the specimen Cost Sheet given, both tins and cases have been included under Packing as part of the cost of the packed product, the cases being non-returnable.

Labour. The total wages paid in the period for each process divided by the throughput determines the cost per cwt.

Overhead Expenses. A detailed schedule of all items of factory expenses is prepared, each expense being apportioned to the respective production departments processes or shops on the most suitable basis. A total is thereby ascertained for each department, from which a rate per unit (1 cwt.) is calculated.

It is to be mentioned that in view of the heavy machinery employed in certain processes of manufacture of both chocolate

Cocoa Cost Summary.

(CAKE MAKING)

Type of Cocoa : *Export "X"*
Butter Content : 25%

Date :
Period : 4
Output : 11,000 lbs.

	Lbs.	Total Cost.			Lbs.	Cost per cwt.	
		£	s.	d.		s.	d.
I. CAKE COST.							
(a) Beans.							
Cocoa beans at 45s. cwt. .	22,400	450	0	0	112	45	0
Brokerage		5	0	0		11	6
Duty		116	13	4		1	8
Delivery		10	16	8			1
	22,400	582	10	0	112	58	3
Process losses and credits :							
Cleaning	200				1		
Shell at 14s. cwt.	3,200	20	0	0	16	2	0
Roasting and winnowing	1,400				7		
Grinding	200				1		
Pressing	400				2		
Value of sack	—	5	16	8			7
	17,000	556	13	4	85	55	8
Treating materials at 18s. 8d. cwt.	200	1	13	4	1		2
	17,200	558	6	8	86	55	10
Less Extracted cocoa butter at 150s. cwt.	6,200	415	3	7	31	41	5
	11,000	143	3	1	55	14	5
Yield cocoa cake							
Cost per cwt.					112	29	2
(b) Labour.							
Cleaning, roasting and winnowing		13	6	8		2	9
Grinding		4	3	4			10
Material treating		1	13	4			4
Pressing		12	10	0		2	7
		£31	13	4		6	6
(c) Factory Overheads.							
Cleaning and roasting		1	13	4			4
Grinding		20	0	0		4	1
Material treating		5	16	8		1	2
Pressing		25	0	0		5	1
		52	10	0		10	8
Total cake cost	11,000	£227	6	5		46	4

COCOA MANUFACTURE

57

Cocoa Cost Summary.

(PACKED COCOA)

Type of Cocoa : *Export "X"*
 Butter content : 25%
 Weight per Tin : 7 lbs.
 Tins per Case : 4
 Cases per cwt. : 4

Date :
 Cost Period No. : 4
 Output : 11,000 lbs.

	Total Cost.			Cost per cwt.	
	£	s.	d.	s.	d.
II. BREAKING DOWN AND PACKING COSTS.					
<i>(a) Powder.</i>					
Cake cost, as per Cake Cost Summary .	227	6	5	46	4
Flavours	4	1	10		10
Process losses :					
Breaking down and sieving		8	2		1
Filling		16	4		2
Ingredient cost	232	12	9	47	5
Labour	7	7	4	1	6
Overheads : Breaking down, sieving and Flavouring Dept.	9	16	5	2	0
Cost of Powder	249	16	6	50	11
<i>(b) Packing Costs.</i>					
Supplies : Tins and labels	49	2	2	10	0
Cases	13	18	3	2	10
Sundries	4	1	10		10
Labour	316	18	9	64	7
Overheads	9	16	5	2	0
	6	11	0	1	4
Total Production Cost	333	6	2	67	11
<i>(c) General Overheads.</i>					
Administration 5%	16	13	4	3	5
Selling 7%	23	6	8	4	9
Advertising 10%	33	6	8	6	9
Distribution	11	0	11	2	3
TOTAL COST	£417	13	9	85	1
Selling Price				100	0
Margin				14	11

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and cocoa, machine-hour rates for the recovery of overhead charges are more satisfactory and are frequently used.

Process Accounts are prepared for each department or process. The costs of materials, labour and overheads are debited, and the output credited, together with any credits arising from by-products and waste. The yield passing to the next process is transferred at cost to the debit of the Process Account.

The first stage is the cleaning of the raw cocoa beans, followed by roasting and nibbing, which removes the shell of the beans.

The product at this stage is known as "cocoa nibs". There are a variety of cocoa beans, and there may be blendings of "cocoa nibs".

The next process is the grinding of the cocoa nibs, followed by pressing. The process creates heat so that there results a viscous "mass". When this "mass" (the trade name) is pressed, cocoa-butter is extracted, and there remains cocoa cake. The cake at this stage resembles a large flattened cheese weighing up to about half a cwt.

The cocoa cake is subsequently ground to a fine powder, and sieved. Further grinding and the addition of any desired flavourings may take place according to the type and quality.

Cost Statements. A summarised Cost Sheet of the process costs is prepared for each period and each type of cocoa. The one illustrated is divided into two parts, (1) Cost of Cake Making on page 56; (2) Cost of Breaking Down and Packing the Cocoa on page 57.

CHAPTER XI

CHOCOLATE MANUFACTURE

THE same initial procedure is followed as for the manufacture of cocoa—viz., the cleaning, roasting, winnowing and grinding of the beans. The cocoa nibs, after blending and grinding, are mixed in a melangeur, with sugar, additional cocoa-butter, and any flavouring. The mixture is passed through steel rollers, thus producing a thick paste, after which there is usually more cocoa-butter added. Further refinement is obtained by rolling or beating in a vessel known as a Conche, which gives the process the name of “conching.”

Chocolate (plain or milk) is moulded into blocks, sometimes with the incorporation of nuts, raisins, etc.

Subsequent operations are wrapping the blocks and packing them in cartons. For despatch they are packed in cases.

The chocolate may be used instead for enrobing—i.e., covering or coating centres. Common centres which come to mind are creams, biscuits, caramels, nut mixtures, marzipan, toffee and sometimes sugar-encased liquors. Centre-making involves separate manufacture and costing.

In addition to the roasting and grinding process losses, provision has to be made in the cost for a small loss in moulding, and “turn of scale” weight.

Method of Costing.—Process Costing is appropriate and the unit of cost at each process is usually 1 cwt. or 100 lbs., as mentioned on page 60.

Procedure.—The cost summaries may be completed for each costing period, as described for cocoa. The general procedure described for cocoa and sugar sweets (*q.v.*) is applicable.

Process Accounts are prepared. For the purpose of illustration, examples of two processes which take place in chocolate manufacture are given below. They are the bean cleaning, and winnowing processes, which disclose the input and output of materials together with credits arising from by-products. Labour and overhead charges are charged to each Process Account, and the value of the net yield is transferred to the next process at the cost from which it emerges from the last process.

The process costs are summarised in a Cost Statement for each costing period.

Cost Statements.—In the Cost Sheet for Plain Block Chocolate illustrated on page 61, only the unit cost is shown, for considerations of space. It may be made more comprehensive by introducing a

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column for total cost in each period. It will be observed that in the illustration the arrangement of the costs is under the headings of materials, labour and factory overheads. This is an alternative arrangement to that of grouping by processes or operations as shown for the breaking down of cocoa costs on page 57.

A separate Cost Sheet should be prepared for each period for each line of chocolate manufactured.

Bean Cleaning.

Department :

Period : 10

Output : 495 cwts.

	Cwts.	Cost.				Cwts.	Cost.		
		£	s.	d.			£	s.	d.
Beans ex Store at 58s.	500	1456	5	0	Cleaned Bean Output .	495	1475	16	8
3d. cwt.		18	15	0	Loss in Cleaning . .	5	—	—	—
Labour		12	10	0	Sack Credit, 400 at 7d. .	—	11	18	4
Factory Overheads .									
	500	£1487	10	0		500	£1487	10	0

Winnowing.

Department :

Period : 10

Output : 396 cwts.

	Cwts.	Cost.				Cwts.	Cost.		
		£	s.	d.			£	s.	d.
<i>Input.</i>					<i>Output.</i>				
Cleaned Beans ex	495	1475	16	8	Large Winnowed Nib.	396	1437	19	8
Cleaning Depart-		19	16	0	Small Winnowed Nib	9	22	10	0
ment		17	7	0	at 50s. cwt.	75	52	10	0
Labour					Shell at 14s. cwt. . .	15	—	—	—
Factory Overheads .					Nibbing Loss				
	495	£1512	19	8		495	£1512	19	8

A Cost Sheet is also required when the chocolates are packed as "assortments". In this case the numbers of each of the items included in the assortment are brought to account at the cost prices of each kind, as shown by the Cost Sheets prepared for each variety.

In the illustration the unit of cost is "one cwt." It is interesting to note, however, that Mr. R. F. Boyes, in a paper published in the *Cost Accountant*, quoted the use of the 100-lb. basis, this being facilitated by fixing all price rates in the factory in

CHOCOLATE MANUFACTURE

61

Chocolate Cost Statement.

Line : 2 oz. Plain Blocks.

No. of Blocks per Outer : 64

No. of Outers per cwt. : 14

No. of Outers per Case : 7

Date

Period No.

Output :

	Lbs.	Price per cwt.	Cost.			Cost.	
			s.	d.		s.	d.
I. <i>Ingredient Cost.</i>					III. <i>Labour per cwt.</i>		
Beans :					Cleaning		9
Cocoa Beans	112	45/-	45	0	Roasting and Winnowing	1	9
Brokerage				6	Grinding, Mixing and Conching	3	0
Duty			11	8	Moulding	2	0
Delivery			1	1	Wrapping	3	3
	112		58	3	Packing	1	3
Process Losses and Credits :					Cost per cwt.	12	0
Cleaning	1						
Shell	16	14/-	2	0	IV. <i>Factory Overheads.</i>	s.	d.
Roasting and Winnowing	2				Cleaning		6
Grinding	1				Roasting and Winnowing	1	2
Value of Sack	—			7	Grinding, Mixing and Conching	2	0
Yield—Cocoa, Pure	92		55	8	Moulding	2	0
Cost per cwt.	112		67	9	Wrapping	2	6
Cocoa, Pure, as above	200	67/9	121	0	Packing	1	0
Sugar	300	50/-	133	11	Cost per cwt.	9	2
Cocoa Butter	70	150/-	93	9			
Flavouring	4	112/-	4	0			
			352	8			
Moulding Loss, 1%			3	6	Summary.	s.	d.
Overweight, 1.5%			5	3	I. <i>Ingredient Cost</i>	70	6
Total Ingredient Cost.	574		361	5	II. <i>Packing Materials</i>	10	6
Cost per cwt.	112		70	6	III. <i>Labour</i>	12	0
II. <i>Packing Materials per cwt.</i>					IV. <i>Factory Overheads</i>	9	2
Wrappers (incl. waste)	950	1/8 m.	1	7	Factory Cost	102	2
Outer Cartons	14	166/8 m.	2	4	Administrative Expenses, 5%	5	3
Packing-case	2	3/- ea.	6	0	Selling Expenses, 4%	4	1
Sundries				7	Advertising Expenses, 3%	3	1
Cost per cwt.			10	6	Distribution Expenses	2	6
					Total Cost	117	1
					Selling Price	130	0
					Margin	12	11

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units of 10, and using weighbridges designed to give weights in 10's, 100's and 1,000 lbs.

Further descriptions of manufacturing and costing procedure of sugar confectionery sweets are detailed in Chapter XXX, and many of the considerations dealt with in that Chapter will be found applicable to the costing of chocolates.

CHAPTER XII

EGG-PACKING STATION

THE growth of large towns during the latter part of the nineteenth century saw the advent of the specialised poultry farmer. The distribution side of the business was always a problem to the small man, and it was not until after the war of 1914–1918 that centres sprang up for collecting and distributing eggs.

With increased competition and the demands of the trade, these centres ultimately took on other functions—testing, grading, cleaning, packing. The egg-packing station has therefore become a very specialised business.

If prices are not controlled, the profit is determined largely by the competence of the management and the acumen of the staff in buying and selling. If, however, prices are fixed, the gross profit is fixed, and the less the expenses of operating the greater the ultimate net profit. In both cases, but particularly in the latter, adequate records, statistical information and frequent periodical Cost Accounts and/or operating statements are a prerequisite to successful control.

The scope of the activities of the station is mainly threefold—collection, packing and distribution. It is with the packing operations that the following paragraphs, forms and statements will deal in detail. The expenses of collection and distribution are, however, very big items of cost, and careful control must be exercised. They are not dealt with here in any detail, as the records necessary are fully recorded in *Cost Accounting and Costing Methods* at Chapter XXII and further observations appear elsewhere in this book at pages 15 and 103.

Packing Operations.—The following operations take place at the station.

The boxes and crates of eggs, already ticketed, are unloaded from the collecting vans at the receiving bay and stacked. Receipts from each farmer are kept separately whenever possible. The eggs are taken from these boxes and placed on a conveyor belt—all except dirty and cracked specimens, which are kept separate. The dirty eggs will be washed, either by hand or mechanically, and then put on the belt. The cracked eggs will be retained, the better ones for sale whole and those badly damaged for disposal in liquid form. The conveyor transports the sound eggs to a grading machine. Probably the most common form is that whereby the egg is projected into a container, which is rotated round a circular table. The latter is divided into segments, and

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intricate mechanism releases the egg at the appropriate segment, according to weight. Standing round the table are operatives, who take the eggs and hold them up, one by one, to an intense beam of light radiated from a small projector attached to the table. The light, shining through the egg, shows up any defects, such as blood spots, and bad specimens are set aside. The good ones, now graded by size and individually tested, are straightway packed into cartons and/or boxes placed by the side of the operatives.

Control Procedure.—At the close of each “run”—i.e., completion of grading, testing and packing of eggs collected from one farmer—a check is taken on quantities by the following records at the various stages :—

- (a) Number received from farmer.
- (b) Total number passed from belt to grading machine (mechanical recorder).
- (c) Total number graded by machine (mechanical recorder at entrance to each segment).
- (d) Quantity packed.
- (e) Dirty, cracked, liquid and bad eggs.

Agreement on these figures should be reached before the packed cases are finally stacked away pending order and delivery. It is most important to make accurate records of the quantities of eggs handled, and to ensure adequate supervision and management, as the margin between buying and selling prices is usually so small that continual “shortages” have a serious effect on profits.

Forms Required.—The following are a few of the specialised forms and records necessary to maintain control.

Stock Control Note. A manifold form, serially numbered, will be specially designed and printed to provide the following labels, slips, notes, etc. :

- (i) Adhesive Labels (for collector to stick on boxes as collected).
- (ii) Receipt Slip (for collector to give to farmer),
- (iii) Eggs Inwards Note (to be completed at receiving bay).
- (iv) Payment Slip (top copy of v and vi).
- (v) Stock Control Note (the top portion will have been completed at the receiving bay ; details of grade of eggs will be inserted by the operatives on the grading machine ; the payment summary will be later completed by the office staff).
- (vi) Copy Stock Control Note (spare copy of v).

An illustration of the Stock Control Note is given on page 65. Sufficient information is inserted for the reader to visualise the remaining portions of the manifold form.

EGG-PACKING STATION

65

Stock Control Note.

Serial No. T 154

Name: *A. Field*

Date: *May 15, 19....*

Address: *High Farm,
Ashampton*

Collector's initials: *G. H.*

Number of boxes collected: *4*

Van Reg. No.: *XYZ 543*

Number of empties returned: *3*

Stock Book Ref. No.: *101/1*

Box number.	Extra Large.	Large.	Medium.	Small.	Extra Small.	Duck.	Spots.	Cracks.	Dir-ties.			Total.
<i>1</i>	<i>31</i>	<i>101</i>	<i>212</i>	<i>51</i>	<i>25</i>	—	<i>7</i>	<i>5</i>	—	<i>Short-packed</i>	<i>2</i>	<i>432</i>
<i>2</i>	<i>37</i>	<i>113</i>	<i>213</i>	<i>30</i>	<i>34</i>	—	<i>5</i>	—	—			<i>432</i>
<i>3</i>	<i>30</i>	<i>104</i>	<i>223</i>	<i>36</i>	<i>26</i>	—	<i>5</i>	<i>6</i>	—			<i>430</i>
<i>4</i>	—	—	—	—	<i>13</i>	<i>65</i>	<i>20</i>	<i>25</i>	<i>113</i>			<i>238</i>
<i>Dirties</i>	<i>3</i>	<i>27</i>	<i>38</i>	<i>11</i>	<i>18</i>	<i>16</i>	—	—	<i>113</i>			
<i>4</i>	<i>101</i>	<i>345</i>	<i>686</i>	<i>128</i>	<i>116</i>	<i>81</i>	<i>37</i>	<i>36</i>	—		—	<i>1530</i>

Foreman: <i>J. Brown</i> Dirties: <i>E. F. J. B.</i> Checker: <i>V. W.</i> Packer: <i>I. S.</i> Stores: <i>A. B.</i> Office. Stock Book: <i>R. B.</i> Checked: <i>H. W.</i> Payment: <i>R. M.</i>				FOR OFFICE USE ONLY.			
				Payment Summary.			
				Quantity.	Type.	Price per 100.	Amount.
				<i>101</i>	Extra Large	<i>11/4</i>	<i>11 5</i>
				<i>345</i>	Large	<i>9/10</i>	<i>1 13 11</i>
				<i>686</i>	Medium	<i>8/4</i>	<i>2 17 2</i>
				<i>128</i>	Small	<i>6/10</i>	<i>8 9</i>
				<i>116</i>	Extra Small	<i>5/4</i>	<i>6 2</i>
				<i>81</i>	Duck	<i>12/-</i>	<i>9 9</i>
				<i>37</i>	Spots	<i>1/-</i>	<i>4</i>
				<i>36</i>	Cracks	<i>2/6</i>	<i>11</i>
							
				<i>113</i>	Less Charge for dirties	<i>2/-</i>	<i>6 8 5</i>
							<i>2 3</i>
							<i>£6 6 2</i>

Eggs Received Book. The information contained in the Stock Control Note is duly inserted in the Eggs Received Book (see form on page 66). At least weekly there is reconciliation with the Eggs Dispatched Book and opening and closing stock.

Eggs Dispatched Book. A specimen entry is shown on page 66.

Daily Time Sheet. An appropriate example of a Time Sheet is shown on page 67.

Various methods of time-booking suitable are described in *Cost Accounting and Costing Methods*, Chapter VII.

EGG-PACKING STATION

67

Daily Time Sheet.

ASHTON EGG-PACKING STATION

Date: May 15
Name: E. Jones

Week No.: 20
Worker's No.: 5

Times.		Work Done.	Hours.	Rate.		Amount.
Start.	Finish.			Ordinary Time.	Overtime Rate.	
8.00	11.00	Loading Belt	3	pence. 8	pence.	£ s. d. 2 0
11.00	11.15	Handling In	1/4	12		3
11.15	12.00	Loading Belt	1/4	8		6
1.00	3.00	Loading Belt	2	8		1 4
3.00	3.45	Cleaning Eggs	1/4	8		6
3.45	5.15	Loading Belt	1 1/4	8		10
		do. (overtime)			12	3
5.15	5.30	Handling In (overtime)	1/4		16	4
						6 0

Worker's Signature: E. Jones
Foreman: J. Brown

Office. Wages Summary: R. M.
Wages Analysis: R. M.
Checked: R. B.

Weekly Wages Summary. This is a useful check on the efficiency or otherwise of those responsible for the various operations, and is in the following form :—

Weekly Wages Summary.

Basis.						
A	Total number of Eggs Received	.	.	.	.	358,160
B	" " " Tested and Graded	.	.	.	.	359,271
C	" " " Packed	.	.	.	.	359,424
D	" " " Dispatched	.	.	.	.	358,600
E	" " " Cleaned	.	.	.	.	1,503
	Total Wages for week	.	.	.	.	£117 10s. 2d.
	Total Cost of Wages per 100 eggs based on number graded	.	.	.	.	7.860 pence

ANALYSIS

	Basis.	Total Cost.	Cost per 1000 Eggs.			
			On Individual Bases.	On Basis B.		
				This Week.	Last Week.	This Week Last Year.
Collection	A	£ s. d. 25 1 4	pence. 16.797	pence. 16.745	pence. 16.123	pence. 16.301
Handling In	A	4 3 2	2.786	2.778	2.781	2.607
Loading Belt	B	9 8 11	6.310	6.310	6.289	6.911
Testing and Grading	B	37 2 4	24.795	24.795	25.112	23.412
Cleaning	E	15 1	12.042	0.504	0.518	0.488
Packing	C	15 9 7	10.336	10.340	10.871	10.007
Delivery	D	18 5 3	12.682	12.200	11.099	10.235
Maintenance and Indirect	B	7 4 6	4.826	4.826	4.830	4.198
Total		£117 10 2		78.498	77.623	72.059
Comments :						

Manager.

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Egg-packing Station Cost Sheet.

OPERATING STATEMENT FOR 20th WEEK, ENDING 18th May, 19.....

Total Dispatched.				This Week.				Last Week.			
				Total 356,600.			Per 100	Total 348,201.			Per 100.
				£	s.	d.	d.	£	s.	d.	d.
Cost of Eggs.											
Opening Stock				50	3	9					
Purchases (per Eggs Received Book)				1,496	19	3					
Closing Stock				1,547	3	0					
				121	11	0					
Cost of Eggs Sold				1,425	12	0	95.9				
Collection Expenses.											
Wages				25	1	4					
Van Maintenance				23	4	7					
Van Depreciation				15	1	9					
				63	7	8	4.3				
Station Expenses.											
Labour.	Handling In			4	3	2					
	Loading Belt			9	8	11					
	Testing			37	2	4					
	Packing			15	9	7					
	Cleaning				15	1					
Plant Maintenance.	Indirect			2	4	6					
	Mechanic			5	0	0					
	Power			20	0	3					
	Repairs			31	2	7					
	Rent and Rates			11	4	2					
Light and Heat				3	18	1					
				140	8	8	9.5				
Administration.											
Office Salaries				25	17	5					
Printing and Stationery				4	0	2					
Telephone and Telegrams				9	19	11					
Insurance				4	3	10					
Management				30	7	3					
Depreciation, F. and P.				1	9	4					
				75	17	11	5.1				
Cases and Cartons, etc.				121	19	4	8.2				
Selling Expenses.											
Advertising				10	1	11					
Travellers' Salaries				27	4	2					
Travellers' Expenses				14	3	10					
Bad Debts				4	16	2					
				56	6	1	3.8				
Distribution.											
Wages				18	5	3					
Van Maintenance				19	18	0					
Van Depreciation				16	13	7					
				54	16	10	3.7				
Cost of Delivered Sales				£1,938	8	6	130.5	£			
Sales, less Returns and Allowances (per Eggs Dispatched Book)				£2,128	19	1	143.3	£			
Profit				£190	10	7	12.8	£			

Comments :

Manager.

The effect of any alteration in the mechanical means is also ealed by this statement.

The Weekly Operating Cost Sheet is shown on page 68. It
ws :—

- (i) Figures for current week with comparative figures for the previous week, and, if desired, the same week last year.
- (ii) Quantity dispatched.
- (iii) Cost of purchases, opening and closing stock, and cost of eggs sold.
- (iv) A summary of expenses distinguishing Collection, Station, Administration, Packing, Selling and Distribution. The analysis and allocation of overheads will proceed along the lines indicated in Chapter IX of *Cost Accounting and Costing Methods*.
- (v) Total Sales, Less Returns and Allowances.
- (vi) The resulting profit.
- (vii) Total figures and pence per 100 eggs.
- viii) Comments by the manager.

CHAPTER XIII

RAG PAPER-MAKING

IN the paper-mill making fine paper, such as notepapers, foolscaps, good types of printing paper, etc., cotton rags, broken paper, wood and fibre are pulped in suitable proportions, with the introduction of caustic bleaching solution.

Each material is placed in a container known as an "engine", which holds about 2 cwt., and twelve engines constitute a "chest", in which the pulping with bleach and antichlor is prepared. For instance, to produce about 4 tons of cream wove paper, about 96 cwt. of materials would be needed, and would be summarised as follows :—

Materials Issued.

Mill: No. 2.

Production Order: No. 26.

Date.....

Cream Wove.

No. of Engines : 48.

Chest No.	Quantities (engines of about 2 cwt.).						Gallons.	
	No. 1 White Cotton.	No. 3 White Cotton.	No. 3 Special.	Papers.	Wood.	Fibre.	Bleach.	Anti- chlor.
No. 1 . . .	5	2	2	2	1	—	78	30
" 2 . . .	5	2	2	2	1	—	78	30
" 3 . . .	5	2	2	2	1	—	78	30
" 4 . . .	5	2	2	2	1	—	78	30
	20	8	8	8	4	—	312	120

When the materials and caustic have been reduced to a milk-like pulp, this liquid runs on to the paper-making machine. It flows over the full width of the first flat surface, which is shaking horizontally, excess water strains off, and the thin layer of yet unformed paper moves over a length of blanket-like material, continuing on over a sequence of large, revolving, cylindrical drying rollers. Thus the wet film of paper gradually "sets" and dries in progressive steps until it leaves the final cylinder as paper, and passes on to the reeler. The reeled paper is then run through a callender in which the desired hardness or gloss can be regulated. From the callender it passes to the cutter, from which it emerges in sheets. As the size specified on the order is required, the sheets are later cut on the "plough" or a form of heavy guillotine. The paper is then removed to the "Salle" for stacking. This is the paper stock room. If a glazed surface is needed, the quantity is

72 APPLIED COSTING IN SELECTED INDUSTRIES

sent to the glazing room for treatment under the pressure of steel rollers. After the cut paper is received in the Salle it is sorted into "good", "retree"—i.e., below standard—and "waste".

At each stage of the above operations some waste or loss arises, and as this affects the costs, a record has to be kept at each operation. As an example the following figures are given :—

	Cwt.	qrs.	lbs.	%	Time on Machine.
Paper over Making Machine .	29	3	9	100	28 hrs. 15 min.
Machine waste . . .		2	26	2.5	
To Salle Callender . . .	29	0	11	97.5	
Callender waste . . .			18	0.5	
To Salle Cutter . . .	28	3	21	97.0	
Cutter waste . . .		1	4	1.0	
To Paper Sorters . . .	28	2	17	96.0	
Sorters' waste . . .		3	27	3.3	
To Plough Trimmer . . .	27	2	18	92.7	
Plough waste . . .			22	0.7	
To finisher . . .	27	1	24	92.0	

Thus the packed sheets weighed 92% of the paper made on the machine.

The above paper was 16½ in. × 21 in., weight 25 lb., packed in 480 sheets to a ream. The packed quantity was 121½⁶/₈ reams—3045 lbs. The actual quantity made, as above, was 3076 lbs., so there was an overweight of 31 lbs. The customer is charged for this unavoidable overweight.

Method of Costing. Unit Output Costing is very suitable, a Cost Sheet being prepared for each production order passed to the mill. Separate unit output costs may be prepared for the callendering, cutting and finishing rooms. A specimen Cost Sheet is given at page 73.

The only comments necessary are that Mill Expenses are apportioned to the respective departments when each department is subjected to cost control. When this is done it should be noted that the cost of steam raised for the paper-making mill should take into account any ultimate usage of exhaust steam for other purposes—e.g., heating other parts of the plant or departments. The exhaust steam may be measured by special devices, or may be estimated by the technical staff, thereby giving a basis of apportionment of the total steam-raising cost.

RAG PAPER-MAKING

73

Mill No. 1 Cost Sheet (Rag Paper).

Quality 088 Cream Wove.

Production O. No. .

48 Engines. Chests 401-404.							
Caustic Galls.	No. of Eng.	Materials.	Weight.			Total.	Total.
			cwt.	qrs.	lb.	s. d.	£ s. d.
250	20	No. 2 Cotton Rag	40	0	0	27 6	55 0 0
136	8	No. 3 do.	16	0	0	17 0	13 12 0
100	8	No. 3 do.	16	0	0	19 0	15 4 0
		Total Rags	72	0	0		83 16 0
76	8	Papers	16	0	0	15 0	12 0 0
	4	Wood	8	0	0	18 6	7 8 0
	—	Fibre	—	—	—		
	48	Total	96	0	0		12 11 5
73		15% on Rags	10	3	5		
635			106	3	5		115 15 5
		Less Waste loss on Machine	4	0	24	15 0	3 3 1
							112 12 4
		Rag Workers' Wages					14 2 8
		Sundry Materials :					
		Caustic, 635 gal. × 0.731 lb.	4	0	15	14 3	2 18 11
		Bleach, 312 gal.	1	1	6	6 9	9 6
		Antichlor, 120 qts. × 0.44 lb.		1	24	14 0	6 6
		Alum, 12 pints × 3.4 lb.		1	12	5 6	2 0
		Starch, 100 lb.		3	16	25 6	1 2 10
		Size, 40 qts.				5	16 8
		Soap, 80 lb.		2	24	50 6	1 16 0
		Gelatine					8 9 7
							16 2 0
		Total Materials Cost					142 17 0
		Wages per Schedule					153 2 5
		Fuel Coal and Mill Expenses, 28 hrs. at 56.5s. per hr.					79 2 0
		Making Cost : 84 cwt. 3 qrs. 2 lb. = 88.3%, per ft. 9.52d.					£375 1 5

Subsequent operations :

Callender Machine treatment.

Cutting machine, reels from Callenders cut into large sheets.

Sorting sheets for good, retree (inferior) and waste.

Plough (or power guillotine) for cutting to commercial size(s) required.

Finishing—wrapping and labelling for despatch to stock or customer.

At each operation further minor loss of paper arises, and cost increases by wages and overheads applied on machine-hour or labour-hour rates.

CHAPTER XIV

ESPARTO PAPER-MAKING

PAPER-MAKING from esparto and wood pulp is an important industry. The principal ingredients are Spanish and African esparto and sulphite. The sulphite is obtained by a process of boiling wood with sulphuric acid. Wood pulp may be mechanically pulped living wood or "chemical wood", or soda-wood pulp.

Esparto, arriving in 33-cwt. bales, is washed in clear water in boilers holding $2\frac{1}{2}$ —10 tons, using a jet of steam and caustic. It then passes to the breaking engines or trough, and drum-washer. The esparto is broken down by a cutter or grinder, and then strained to extract roots, dust, etc.

The next processes take place in towers about 20 ft. $\times$ 8 ft., tile lined. The pulp is put in together with chlorine bleaching-powder. This is a specialised operation, and the extent of treatment has to be judged by men of many years' experience. In this process, size (resin and alum) with an appropriate colouring matter are introduced. Also starch if a paper with "crackle" is required. In about four or five hours the pulp passes to machine chests, from which it is fed to agitated sand traps or tables with felt baffles. It passes over a close wire strainer, which has side straps to hold it in position, and the water drips through. The side straps determine the width of the paper. As the strained pulp is drawn over, suction boxes extract further moisture. A "dandy roll" may be inserted at this stage, so that whatever design is worked on it is impressed to form a watermark in the nearly formed paper. The soft paper passes under a felt roller, which presses out the remaining water, and thence over a series of cylinders for complete drying. Surface finish is given by steel callenders, and the paper is wound on to large rolls.

Subsequent operations include cutting into sheets (*e.g.*, $17\frac{1}{2}$ in. $\times$ $22\frac{1}{2}$ in., $16\frac{1}{2}$ in. $\times$ 21 in. and 30 in. $\times$ 40 in.), sorting examination, packing into reams (usually 500 sheets, but sometimes 516's, as for featherweight woves and laids). Some orders are for paper guillotine trimmed. Water-marked papers may be cut irrespective of the position of the water-mark, but sometimes have to be "cut to register" so that the water-mark design is intact on each sheet.

Types of Esparto Paper (including paper in which straw pulp or soda-wood pulp is substituted for esparto fibre) are represented by :—

Imitation Art : 16 lb. to 26 lb., $17\frac{1}{2}$ in. $\times$ $22\frac{1}{2}$ in., 500's.

Duplicator : 14 lbs. to 19 lbs., $16\frac{1}{2}$ in. $\times$ 21 in., 500's.

Featherweight Wove and Laid : 30 in. × 40 in., 516's.
 Cream Laid and Woves, including Antique Woves, Parchment and Vellum
 papers : 16½ in. × 21 in., 500's.
 Machine Finished Printings, Offset Cartridge, Lithos and Enamellings.
 17½ in. × 22½ in., 500's.
 Cartridge Papers.
 Engine Sized Bonds.

Method of Costing.—This type of product is well suited to Unit Output Costing. The units of cost are “per ton” and “per lb.”.

Cost Sheets.—Costs of materials weighed and introduced into the plant and wages are summarised on the Cost Sheet, which will be prepared weekly when there is a long run of production to a particular specification. Should there be smaller production or stock, orders of (say) 1–10 tons or more, the Cost Sheet may be finalised on completion of each order.

An example of a Cost Sheet is illustrated on page 76. The details from which the Cost Sheet is prepared are often first entered from original data on to analysis schedules, from which totals are transferred to the Cost Sheet.

CHAPTER XV

RECOVERY OF SILVER AND GOLD FROM ELECTROLYTIC COPPER REFINERY SLIME

IN the electrolytic refining of copper a mud or slime accumulates in the electrolytic cell. These slimes contain traces of a number of metals, the chief being gold and silver, which are recovered by metallurgical treatment.

Crude copper anodes are charged into the electrolytic cell, remaining in circuit for six weeks, in which period there are two drawings of cathodes or refined electrolytic copper. At the second lifting the solution and slime are drawn by a lead-lined launder into a slimes tank, passing over a fine screen to remove nodules of copper, and then pumped to a surge tank to be filtered.

The slimes from the filter are then roasted at the rate of up to 3 tons a day. The calcined slime is then leached with the foul electrolyte from the copper refinery, and on decanting the liquor (copper sulphate solution), the residue is washed, filtered and given furnace treatment to obtain gold-silver bullion, which is cast into anodes weighing about 150 oz.

An electrolytic parting process results in the separation of the silver from the gold. The silver goes into solution and deposits as silver crystals on the cathode. The gold remains as fine black mud in the muslin bags in which the anode was suspended. In this process a full charge of the battery of twenty-five cells is seventy-five anodes (about 11,000 oz.) of gold-silver bullion.

The metallic silver crystals are removed from the graphite cathodes once a day, melted down and poured into 1,000-oz. bars of practically pure silver.

The gold mud or "black gold" from the muslin bags is washed, boiled in a cast-iron pot with sulphuric acid to purify it, filtered and charged with borax flux into a graphite crucible, from which molten gold is cast into 500-oz. bars.

The Method of Costing.—Process costs may be prepared and shown in three operations: (1) Slimes Treatment, (2) Bullion Furnace, (3) Electrolytic Parting.

Overheads to be apportioned are the expenses of the plant services (steam, air, water, power, maintenance, machine shop, and stores handling) and general refinery expenses. The bases of allocation are dealt with in Chapter XI and the schedule on page 140 of *Cost Accounting and Costing Methods*. The general refinery expenses can be applied as a unit cost per 1000 oz. of fine gold and silver.

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Process Cost Sheet.

Cost Period No. : 10. 31st December, 19.....

1. Slimes Preparation Process.

Output, tons				73.15	
Total.				Per Ton.	Period 9.
£ s. d.				£	£
Process Labour :	£	s.	d.		
Slime and Sludge Tanks .	213	3	0		
Filtration and Calcination	355	4	0		
	568	7	0	7.770	
Supplies	280	8	0	3.833	
Maintenance :	£	s.	d.		
Labour	95	7	0		
Materials	193	0	6		
	288	7	6	3.942	
Service Costs as Schedule	511	0	0	6.986	
Process Overheads 27.5% on Labour .	156	5	10	2.137	
	£1804	8	4	24.668	

2. Bullion Furnace Process.

Anodes Output, ozs.				576,234	
Total.				1000 oz.	Period 9.
£ s. d.				s. d.	s. d.
Process Labour	494	0	0	17	1.75
Supplies	953	18	0	33	1.30
Maintenance :	£	s.	d.		
Labour	63	16	0		
Materials	159	19	0		
	223	15	0	7	9.19
Slag Leaching :					
Labour	43	4	7		
Materials	30	16	0		
	74	0	7	2	6.83
Service Costs as Schedule	194	0	0	6	8.80
Process Overhead 27.5% on Labour .	135	17	0	4	8.58
	£2075	10	7	72	0.45

3. Electrolytic Parting Process.

Output, oz. :				Fine Gold			424,259			
				Fine Silver			95,500			
				Total, oz.			519,759			
				Total.			1000 oz.		Period 9.	
				£	s.	d.	s.	d.	s.	d.
Process Labour				400	0	0	15	4.70		
Supplies				420	0	0	16	1.94		
Maintenance : £ s. d.										
Labour 68 10 0										
Materials 152 15 0										
				221	5	0	8	6.16		
Service Costs				88	0	0	3	4.63		
Administration 50.793d. per 1000 oz. .				110	0	0	4	2.79		
				£1239	5	0	47	8.22		

Cost Sheets.—The Cost Accounts, prepared for convenient cost periods, provide totals for the cost summaries. The presentation of a Cost Sheet for each process at monthly or other regular intervals, with columns for comparative previous periods, is a useful aid to management. It will be noticed that the cost is practically the same for both gold and silver recovered.

CHAPTER XVI

GARAGE REPAIR SHOP

THIS subject has been introduced as a simple example of typical job costing.

The work and costs are concerned with repairs involving a variety of circumstances. In some cases the car is delivered under its own power to the garage, in others a towing car, or a breakdown vehicle equipped with hoist and tackle, will be needed. The nature of the repair may be indicated by the customer, or it may have to be discovered by the mechanic.

A Job Card, serially numbered, will state the nature of the work required, and usually it is in a form which enables details to be entered of the work performed, accessories used from stock, parts specially purchased, and incidental expenses directly chargeable, such as petrol, oil, fares and other petty payments.

The Method of Costing is Job or Terminal Costing, the unit of cost being each job.

It is advisable to keep operating cost accounts for the costs of maintaining the breakdown-lorries (*a*) for annual fixed and semi-fixed costs, (*b*) running costs, so that a basis of charge when used may be determined.

Procedure.—A Repair Job Card will be made out in the office, recording in the first section date, customer's name and address, particulars of the car and instructions given by the owner. In due course the manager or foreman will enter in the second section the work to be done. As the work proceeds, details of work actually executed will be recorded in the third section.

On the back the Job Card is ruled to show details of labour, accessories issued from store or bought in, out-of-pocket expenses, standard charges for service work, and a general summary of the total charges. A suitable form is illustrated on pages 84–85.

When the breakdown lorry is used, a Job Card should be issued, or journal record made, so that the charge may be determined. A suggested form appears on page 84.

Labour.—Mechanics will record time spent on inspection, and on each main operation. Time Sheets are usually used, but Job Clock Cards are convenient, and are used in larger garages. Normally time wages are paid, and the foreman signs the Time Sheets.

Use of Breakdown Lorry.

Name : <i>A. Jones.</i> Address : " <i>The Willows,</i> " <i>Sevenoaks.</i> Time of Departure : <i>11.15 a.m.</i> Time Returned to Garage : <i>2.15 p.m.</i>	No. : <i>1063.</i> Date : <i>30/6/....</i> Make of Car : <i>Speedy.</i> H.P. : <i>8.</i> Reg. No. : <i>72345 X.</i>																																	
Labour : <i>T. Drake.</i> <i>3 hrs. at 1/3 hr.</i> Running charge : <i>20 miles at 9d. mile</i>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right;">£</td> <td style="text-align: right;">s.</td> <td style="text-align: right;">d.</td> </tr> <tr> <td></td> <td style="text-align: right;">3</td> <td style="text-align: right;">9</td> </tr> <tr> <td></td> <td style="text-align: right;">15</td> <td style="text-align: right;">0</td> </tr> <tr> <td colspan="3" style="border-top: 1px solid black;"></td> </tr> <tr> <td></td> <td style="text-align: right;">18</td> <td style="text-align: right;">9</td> </tr> <tr> <td></td> <td></td> <td style="text-align: right;">11</td> </tr> <tr> <td colspan="3" style="border-top: 1px solid black;"></td> </tr> <tr> <td></td> <td style="text-align: right;">19</td> <td style="text-align: right;">8</td> </tr> <tr> <td></td> <td style="text-align: right;">2</td> <td style="text-align: right;">0</td> </tr> <tr> <td colspan="3" style="border-top: 1px solid black;"></td> </tr> <tr> <td></td> <td style="text-align: right;">£1</td> <td style="text-align: right;">1 8</td> </tr> </table>	£	s.	d.		3	9		15	0					18	9			11					19	8		2	0					£1	1 8
£	s.	d.																																
	3	9																																
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	18	9																																
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	19	8																																
	2	0																																
	£1	1 8																																
Establishment charges : <i>5%</i> Profit : <i>10%</i>																																		
Transferred to Job Card : <i>1001.</i> Initials : <i>E. W.</i>																																		
Signed : <i>H. Jones.</i>																																		

Repair Shop Card (*Front*).

Job No. : *1001.*

Name : <i>A. Jones.</i> Address : <i>The Willows,</i> <i>Sevenoaks.</i> Telephone—Home : _____ —Business : <i>City 12345.</i> Car required by : <i>4th July.</i> To be collected by : _____ To be delivered to : <i>Home address.</i>	Date : <i>30th June, 19....</i> Make of Car : <i>Speedy.</i> Colour : <i>Blue.</i> H.P. : <i>8.</i> Reg. No. : <i>72345 X.</i> Eng. No. : <i>451273.</i>						
Work required—Special : <i>Attention to Big-end Bearings.</i>							
Work required—Standard (any not required mark ×). Grease up all round Top up gear box, back axle and battery Spray springs Wash and sponge and leather Polish	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right;">Initial when completed.</td> </tr> <tr> <td style="text-align: right;">A. S.</td> </tr> <tr> <td style="text-align: right;">× —</td> </tr> <tr> <td style="text-align: right;">C. D.</td> </tr> <tr> <td style="text-align: right;">C. D.</td> </tr> <tr> <td style="text-align: right;">C. D.</td> </tr> </table>	Initial when completed.	A. S.	× —	C. D.	C. D.	C. D.
Initial when completed.							
A. S.							
× —							
C. D.							
C. D.							
C. D.							
Special work executed (details) : <i>Removed sump and two pistons.</i> <i>Examined and adjusted 3 big-end bearings.</i> <i>Fitted one new con-rod.</i> <i>Sump washed out ; oil filter cleaned.</i> <i>Refitted sump, filled with oil and tested.</i>							
Signed : <i>J. Coa.</i> Certified complete : <i>M. Anoger.</i>							

Repair Shop Card (*Back*).

Repair Shop Card (Back).

Job No. 1001.

Labour.										Accessories—ex Stores.											
Date.	Mechanlo.		No.	Hours.	Over-time Hours.	Rate.					Date.	Req. No.	Details.	Quan.	Price.						
	Name.								£	s.						d.	£	s.	d.		
30/6	Amery		13	3		1/6						5123	Sump Packing .	1	4d.				£	s.	d.
1/7	Baxter		21	1 1/4		8															4
2/7	Amery		13	1		1/6															
	Baxter		21	2		8															
	Amery		13	2		1/6															
	Cox		8	2		2/3															4
	Cox		8	2	3	3/6															
	Baxter		21	2	2	8															
	Baxter		21	13 1/4	5	1/-															
							£1	9	8												

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For time spent on general maintenance, garage repairs—*e.g.*, petrol pumps, machines—and idle time, standing order numbers will be scheduled, so that the men can quote them on Time Sheets with the time so occupied.

The following is a specimen Time Sheet :—

Daily Time Sheet.

Mechanic's Name : <i>J. Cox.</i>			Date : <i>2nd July.</i>			
,, Number : <i>8.</i>			Week No. : <i>27.</i>			
Job No.	Standing Order No.	Work Executed.	Hours.		Time.	
			On.	Off.	Ord.	O'time.
<i>1003</i>	<i>W 1</i> <i>W 1</i>	<i>Decarbonising</i>	<i>8.00</i>	<i>11.30</i>	<i>3.30</i>	<i>3.00</i>
		<i>Adjusting lathe</i>	<i>11.30</i>	<i>12.00</i>	<i>0.30</i>	
		<i>do.</i>	<i>1.00</i>	<i>2.15</i>	<i>1.15</i>	
<i>1007</i>		<i>Adjusting brakes, etc.</i>	<i>2.15</i>	<i>3.30</i>	<i>1.15</i>	
<i>1001</i>		<i>Fitting Con. Rod</i>	<i>3.30</i>	<i>8.30</i>	<i>2.00</i>	
					<i>8.30</i>	<i>3.00</i>
Entered : <i>S. B.</i>			Mechanic's Signature : <i>J. Cox.</i>			
Summarised : <i>J. W.</i>			Foreman's Signature : <i>B. Brown.</i>			

The Time Sheets are collected daily, and the time and labour cost is entered on the various Job Cards in the office. The amounts so charged are reconciled with the total of the pay-roll each week to ensure accuracy.

In a large garage it may be desirable to have "Testing Cards" and "Delivery Cards" on the lines of the "Break-Down Lorry Card" illustrated.

Materials.—Parts and sundries will be issued against requisitions signed by the foreman. Requisitions may be used similarly for special purchases for parts not stocked. Specimen forms are illustrated on pages 30 and 39 of *Cost Accounting and Costing Methods*, where general stores procedure is described in full detail. Charges to the Job Card may be made direct from the priced requisitions, or from a Material Abstract Summary.

Overheads of the Repair Shops.—Detailed records must be kept of usage of indirect materials (cleaning rags, oil, grease, etc.); of indirect wages (manager, foreman, clerks, labourers and cleaners); and of sundry apportionments of insurances, rent, rates, electricity, power and loose tools. Depreciation of plant and equipment used in the repair shop, together with the expenses referred to, will be

ascertained each year, and resolved into a suitable recovery rate. This rate may be (a) a percentage on direct wages, or (b) a rate per direct labour-hour, the latter being much more accurate. The labour-hour rate is determined by dividing the total repair-shop overheads by the total direct labour-hours based on past records, but adjusted as closely as possible for current conditions.

Direct Expenses, such as telephone calls, fares and other out-of-pockets, may be charged to the job concerned by means of expenses vouchers.

General Administration Overheads, as shown by the Profit and Loss Account, are calculated as a percentage on cost.

Fixed Charges for Standard Jobs, like cleaning cars, polishing, greasing, spraying springs, etc., are customary, varied according to the size or horse-power of cars. Such charges will be based on average costs, although they may have to conform with charges made by other garages.

The Cost Summary on the Job Card will be made from the totals of the various sections on the card, and forms the basis of the invoice to the customer.

CHAPTER XVII

WOOD CASE-MAKING

THE making of wood cases is a specialised industry, and although commonly used sizes are made for stock to meet relatively small orders, it is more usual for the cases to be made to customers' specifications as to size, strength and detailed special features—*e.g.*, quality of timber, length, width, thickness of ends and sides, tops and bottoms, battens, dove-tailing and perhaps provision of handle holes. These features vary according to the type of trade. The cases are often supplied to manufacturers in the form of "Shooks" or sets of parts unassembled, but they are also delivered as completed cases.

The operations consist of: (1) sawing timber into thicknesses required (deep cutting); sawing into desired widths (ripping); and sawing into lengths (cross-cutting); (2) assembling by nailing or other means; hoop-ironing, stencilling, etc.; (3) any special extras required in connection with operations (1) or (2).

Method of Costing.—"Terminal" or "Job" costing is particularly suitable, a job or order number being given to each order, whether special or for a regular "stock" line. The usual unit of cost is "per case".

Procedure; Materials.—The main material is timber, usually bought from merchants in various sizes suitable for economical use, selected from the standard sizes in which imported.

In war-time, control licences may have to be accepted in sizes or types other than those usually carried.

When home-grown timber is used it is necessary as a rule to stack it for seasoning, unless artificial seasoning is adopted. This affects costs, as stated in Chapter XVIII at page 95.

The timber is stacked according to size and variety, and usual stores records of receipts and issues are maintained. Quantities surplus to particular jobs may arise, and may be returned to store, with a Stores Debit bearing the job number to enable the job to be credited. If surplus timber is transferred to another job, a Transfer Note should be made out, giving particulars as to the job to be credited and the new job number to be debited. Transfers also arise, for example, when after starting one or more operations it is found that the timber is not suitable; it may have to be returned to store in a partly processed condition. As to whether the full cost in that condition can be charged for subsequent use will depend on circumstances, and this has to be taken into account when crediting the original job.

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Sundry materials are nails, hooping iron, printing inks, stencils, etc. Issues are made in convenient quantities rather than against requisitions for each works order. Technical calculations form the basis of the charge against each job, including wastages appropriate. Periodic check on issue, usage and workshop stock permits of necessary adjustments. Stencils are a direct charge.

Scrap. Firewood and sawdust result. It is convenient to credit net realised value to saw-mill overheads.

Labour.—Job Time Sheets or Clock Cards should be used whereby each man can record job number, operation, time on each job and operation. Unless regularly on a particular machine, he should indicate his time on each machine; suitable forms are illustrated on pages 68 and 69 of *Cost Accounting and Costing Methods*.

Time or piece-work rates are usually paid, but a "points" or "time-unit" scheme is used by some firms, particularly on assembly operations.

For purpose of debiting direct wages to Cost Accounts a Wages Abstract or Analysis Summary is prepared on the lines of the example on page 161 of *Cost Accounting and Costing Methods*.

Indirect labour wages are included in saw-mill and case-making departmental overheads respectively.

Overhead Expenses.—These are apportioned or charged on usual bases to (a) Saw-mill, (b) Case-making, (c) Stores, (d) Administration.

The saw-mill overheads may be further apportioned to the various machines, so that machine-hour rates can be calculated. When this cannot be done, a percentage on direct wages or a labour-hour rate may be used at the sacrifice of some degree of accuracy. Any of these alternatives are much more reliable than the adoption of a charge per standard of timber as used by some ill-advised producers. In the assembly shops labour-hour rates are calculated for manual operations.

Many firms apply overheads as a charge per standard of timber sawn, but this gives inaccurate results, owing to such factors as varying number of cuts for different sizes, dove-tailing, handle-holing and other special operations. Similar inaccuracies arise when the overheads are resolved into a "per case" charge.

Timber store handling expenses can be applied as a charge per standard of timber issued to the works.

Administration overhead can be applied as a percentage on works cost. The use of a rate per case (including sets or shooks as cases) or per standard of timber, unfortunately used by many firms, is inaccurate, for the reasons already stated in regard to works overheads.

Distributive Expenses consist mainly of carriage outwards,

Job Cost Sheet for Cases.

Job No. : 123.

For : (Stock or Customer's name)

Specification : Inside measurements— $21\frac{1}{8}'' \times 11'' \times 17\frac{3}{8}''$.Tops and Bottoms— $\frac{3}{8}''$ thickness.

Sides— ditto

Battens and Ends— $\frac{7}{16}''$ thickness.

Battens—2'' wide.

Quantity : 3000.

Stencilled XYZ.

6/19....

SAWMILL COSTS.									
Timber.									
	Stand-ards.	Kind.	Per St.				Per Case.		
				£	s.	d.	d.		
.....	10.000	Imported Deals	£45	450	0	0			
.....	0.500	Home-grown	£30	15	0	0			
	10.500			465	0	0	37.200		
Labour.									
				£	s.	d.			
Cross-cutting				30	1	0			
Ripping				20	0	0			
Deep-cutting				14	19	0			
Other				—	—	—			
				65	0	0	5.200		
Prime Cost				530	0	0	42.400		
Overheads.									
			Hrs.	Rate.					
Cross-cutting			30	10/-	15	0	0	1.200	
Ripping			20	13/9	13	15	0	1.100	
Deep-cutting			25	8/-	10	0	0	0.800	
Other			—	—					
Saw-mill Cost of Shooks									
CASE-MAKING.									
Sundry Materials.									
Nails		2 cwts.	43/6	4	7	0	0.348		
Stencils				1	0	0	0.080		
„ Ink		1 gal.	8/-		8	0	0.032		
Hoop-iron		2			10	0	0.040		
Labour, Assembling				40	0	0	3.200		
Overheads.									
			Hrs.						
Nailing Machine		20	10/-	10	0	0	0.800		
Manual Operations		25	5/-	6	5	0	0.500		
Factory Cost				631	5	0	50.500		
Administration, 7.5%				47	6	10	3.787		
Total Cost at Works									
				£678	11	10	54.287		

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which includes transport by own vehicles. Actual carriage or a charge on a ton-mile basis for own vehicles will be made to each job.

Selling Expenses include Travellers' Salaries and/or Commission, Travellers' Expenses, Advertising, Bad Debts, etc. Charge will be made to each job as a percentage on Sale Value.

Saw-mills employ del-credere agents. These agents, receiving orders from customers, allocate necessary quantities to one or other of the various mills for which they are agent, and receive as remuneration a commission on the sales value. In these cases the commission is often the only selling expense, as the del-credere agent carries the bad debts risk.

Cost Sheet.—A convenient form of Cost Sheet is illustrated on page 91.

It is a common practice to sell cases on estimated costs, and there is considerable advantage in completing an "actual" cost sheet, so that causes of deviation from estimates can be ascertained.

CHAPTER XVIII

FURNITURE AND WOOD-WORKING COSTS

DOMESTIC furniture reveals extraordinary variations in types and designs. The term "modern furniture" covers all output of the industry, irrespective of design or style. It includes replicas of antiques or pieces of genuine individual design in which the designer has sought to express his own ideas rather than imitate the standard set by craftsmen of the past, but whose influence remains. Whether designs follow traditional lines, or merely hint at the style of a particular period, or are truly modern, the costing problem remains the same. Recent years have witnessed revolutionary changes in the materials utilised. New materials introduced—*e.g.*, steel, glass, plastics—have had a marked effect on production methods. In this chapter the underlying principles of these methods are considered.

Production Routine.—It is necessary to find the cost of production of a particular unit of furniture in itself separate and different from other pieces of another design. The system in the factory must accordingly provide for each classified design to be given an identity reference, which is preserved throughout all stages of production. This is the keystone of successful control.

Production methods vary widely in different factories, and are necessarily dependent upon the type and quality of furniture it is the policy of the management to produce. Competitive conditions have created within the industry the need for changes in style and design at least once a year, consequently production periods are generally capable of precise determination.

Within these periods the factory may produce a large number of each design decided upon, either in one batch or in a series of batches. In general, the policy is to determine the range of designs to be produced in each trading year. It is another matter of policy and production planning whether the designs are to be produced in predetermined quantities in anticipation of demand, or placed on the market in small numbers, or sold from illustrations and manufactured in batches of the greatest possible number when the demand has been ascertained.

Intensive or even mass-production methods are much used. To this end parts common to more than one suite of furniture may be comprised in a production order—*e.g.*, certain small chairs may be suitable for more than one dining-room suite and even a bedroom suite. Notwithstanding, it is necessary to main-

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tain records, as described later, which will enable the cost of production of each design to be ascertained.

The control of timber, its seasoning over long periods or by mechanical kiln-drying and the method of issue, introduce unusual features, which will be described when dealing with costing procedure in a later paragraph. An interesting feature in connection with furniture and wood-working is the use of "Rods" or "Master Materials Boards". These are boards of the actual size and thickness to be used for a particular production order. The surface is rubbed smooth and the precise shapes or design and actual size of the part or parts to be cut out of such a board from stock are drawn upon it by the draughtsman and detailed particulars as to exact measurements and finished sizes are also carefully stated on this "Rod" or "Master Board", which is also given the production or job order number. (This is referred to on page 68 of *Cost Accounting and Costing Methods*.) These control boards are carefully registered and stored, as it is with the aid of them that the storekeeper selects the timber suitable for issue, and the experienced timber worker cuts his timber.

The departments are well defined, and include (a) Saw Mill and Machining, (b) Chair and Cabinet Assembly, (c) Carving, (d) Polishing (Spray Finish), (e) Polishing (Hand Finish), (f) Fittings and Hardware Assembly or Fitting-up, (g) Upholstery (including Fabric Cutting), (h) Despatch.

Method of Costing.—Normally Job Costing is maintained within the intensive or mass-production methods used. By this means the identity of each design is preserved and cost data are so arranged that the cost of production of each design can be determined. This provides, *inter alia*, information upon which selling prices may be decided by the management, and in particular provides a guide as to the minimum price possible without loss when competition is keen.

The unit of cost is usually an individual article or piece, but sometimes for domestic furniture a suite may be adopted as the unit. Thus the units for a given design might be: (a) small chairs, (b) sideboard, (c) table; or (d) the corresponding complete dining-room suite. Similarly, units might be, (a) wardrobe, (b) dressing stool, (c) dressing chest, (d) bedstead; or (e) the corresponding complete bedroom suite. The advantage of the small item units is that when a chair or other item is capable of inclusion in more than one suite, it is a simple matter to obtain a suite cost.

Procedure for Costing. (1) **Materials.** (a) *Timber* is the most important material in cabinet work. The timber stock records, therefore, should be controlled by the operation of a *Timber Control Account*. The primary stores record is a *Daily Timber*

Inwards Sheet written in duplicate. On arrival, timber is examined and measurements are checked, and the boards stacked according to sizes, and details entered on the appropriate Stock Cards (or Sheets) from the retained copy of the Timber Inwards Sheet. The original copy is passed to the Accounts Department for checking suppliers' invoices, so that after payment, and analysis, entries in the Cost Journal can be made for posting to the appropriate Timber Stock Account.

(b) *Timber Consumption*. A Timber Requisition Note is the authority for issue of timber. It bears the Production Order Number, and enables the boards to be debited to the particular design concerned, as the Requisition Notes are summarised by the storekeeper on Daily Timber Issued Sheets, in form of an abstract which provides totals of each item for the Stores Ledger Accounts concerned. The originals are sent to the Cost Office, where they are summarised on an abstract, under Production Order Numbers, so that the appropriate Job Account can be debited. (See example on page 161 of *Cost Accounting and Costing Methods*.) The production order is always accompanied by the Master Materials Board already described. From the information on the Master Board the timber storekeeper or the saw-mill foreman selects the timber for issue, which demands experience and skill.

(c) *Timber Wastage* in cutting can be ascertained with the aid of the Master Board. The net timber necessary as shown by the Master Board, compared with the cubic content of the boards actually issued against each production order, enables the wastage to be calculated. Such wastage varies according to the design and timber used. This method of assessing wastage against each design is more reliable than the practice adopted by some manufacturers of calculating an overall average wastage irrespective of design or type of timber.

(d) *Timber Returned to Store* is entered on a Timber Returned Sheet, in duplicate. One copy is used by the storekeeper, the other by the Cost Office.

(e) *Pricing of Issues of Timber*. The cost of timber consists of the delivered price, plus any additional cost of seasoning. If seasoning and storage extend over more than one year, it is usual to add a percentage for interest, and for convenience an average addition of about 2% per annum is debited to each Stock Account concerned. When a marked depreciation arises, an adjustment at the end of the trading period is made by debiting Profit and Loss Account and crediting the Stock Account affected.

When natural drying by storage in the open over a period of years is avoided by the use of mechanical kiln-drying, the cost of this process is debited to the Timber Account concerned. This cost consists of maintenance of the kiln, labour, fuel and other

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Production Stock Order.

	Design.	No. Wanted.	Wood.	Finish.	Further Details.	STOCK ORDER No. No. 3748 Date Issued 14 Dec., 19...		
Bed Cabinets								
Bed Chairs								
Bed Settees								
Bed Settee Suites								
Chesterfield Suites	510	1000	Oak	Jaco.	At once.	Machine	x	
Settees						Cabinet		
Easy Chairs						Chair		
						Carving		
						Polishing		
Small Chairs						Passed Foreman 		
Hallstands								
Details of cut parts or specials								
.....								

Special Order.

Customer's Name : A.B.C. & Co., Ltd.
Address : Huddersfield.

Date Wanted : 20 Dec., 19...
Despatch via L.M.S.

Job Order No. 405
Date : 1 Dec., 19...

Quan- tity.	Design.	Description.	M/O	Cab.	Ch.	Pol.	Uph.	F.U.
50	1234	Easy Chairs			x	x	x	
REMARKS :—Any special remarks may be made here.			Order Book : W. J. Despatch Book : G. W. Day Book : A. B.	Despatch 20.12.19... No. of sheets sent 25	Passed on 18.12.19... FOREMAN J. L.			

incidental expenses, and is recovered as a rate per cubic foot of the timber treated.

The cost of each type of timber so determined, the price of issue, has to be calculated. It is usual to determine a weighted average for convenient periods—e.g., six-monthly. This avoids fluctuations, since the timber normally remains stored for some years before entering production.

(f) *Other Materials*, such as ironmongery, polishes, stains, upholstery fabrics and materials, are subject to usual stores procedure, described in *Cost Accounting and Costing Methods*, Chapters IV and V.

(g) *Upholstery Fabrics*. It is a common practice to permit trade customers to select the upholstery fabric preferred. Consequently, production up to the point of completion of the timber frame is by means of production stock orders.

Subsequent production to the finished upholstered stage proceeds on Job Order Numbers.

The movement of each upholstery covering material is therefore important. Stock control involves the showing in good time, whether a particular material is selling well or otherwise. Changing fashion, even in a single season, may cause a substantial drop in values. A good practice is to employ coloured signals to show at a glance: (a) how long a material has been in stock; (b) whether only a short length is available for immediate use, but further supplies possible; (c) whether further supplies are on order. By changing the colour signals in respect of (a) above, fabric which has been in stock more than one season can be indicated, thus suggesting caution against further purchases even though in current demand. A suitable form is shown on page 98.

(2) **Labour** comprises skilled or semi-skilled operators of highly automatic machinery and craftsmen of inherent personal skill developed by lifelong training. Before the gradual mechanisation of the industry, and the modern transport facilities, the furniture industry was established for centuries by the craftsmen in such places as High Wycombe in England, and Bieth and Lochwinnoch in Scotland, but now modern factories are widespread.

(a) *Labour Records*. Intensive or Mass-Production Methods lend themselves to comparatively simple procedure for recording labour costs. The Factory Order Form shown on page 96 forms the basis of reference, and the departmental Job Cards (pages 99–100) enable time spent by direct labour to be recorded under the appropriate Factory Order Number. The specimen Machine Department Job Card (page 99) introduces an interesting feature—namely, a printed list of process numbers on the back of the card

Stock Card.

Upholstery Cover Material.

Card No.

Qual.	Design No.	Suppliers.	Suppliers No.	Price.	Whether Repeatable.	
<i>Y</i>	<i>1240</i>	<i>H.B. Co., Huddersfield.</i>	<i>0421</i>	<i>0/5</i>	<i>Yes.</i>	

Date.	Yardage Received.	Cut Issued.	Description Customer's Order.	Customer's Name.	Sales Order No.	Balance in Yds.	Remarks.
<i>19... Dec. 1</i>	<i>1000</i>	<i>50</i>	<i>To 1234 Easy Chairs.</i>	<i>A.B.C. & Co., Ltd.</i>	<i>405</i>	<i>950</i>	

Qual.	Design No.		Came in Stock (Month).				M.	J.	J.	A.	S.	O.	N.	D.	Under Suite Length.	Further Pieces Ordered.	
			J.	F.	M.	A.											
<i>Y</i>	<i>1240</i>	<i>Tapestry</i>												<i>x</i>			

for reference to minimise the danger of misquoting the operation numbers, as follows :—

- 1 One Bit Borer (Vertical).

2 Three Bit Borer.

3 Seven Bit Borer.

4 Belt Sander.

5 Table Sander.

6 Surface Planer (1).

7 Surface Planer (2).

8 Panel Planer (4).

9 Mortice.

10 Circular Saw.

11 Band Saw.

12 Squaring Saw.

13 Fret Saw.

14 Panel Planer.
- 15 Four Cutter Planer.

16 Spindle

17 Large Sander.

18 Dovetailer.

19 Matching and Jointing.

20 Drawing in.

21 Lining.

22 Looking out.

23 Feather and Groove.

24 Swing Saw.

25 Fourteen Bit Borer.

26 Small Squaring Saw.

27 Straight Line Edger.

28 Router.

Another safeguard is the printing at the foot of each card of the words : only card ; card to follow ; last card. The deletion of the inappropriate words by the foreman or person certifying the

Job Card (*Front*).

MACHINE
DEPT.

Job No..... Qty.

Design No.

Article

.....

	Check No.	Machine No.*	On.	Off.	Total.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

* See List overleaf.

Only Card :
Card to Follow
Last Card :
Foreman's
Signature

On the reverse of this card is printed a numbered list of all the machine operations for Col. 3 as referred to on page 98. The numbers in the first column merely show at a glance the number of operations done.

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Job Card.

POLISHING

DEPT.

Job No.

Design No.

Article

Week ending

Qty.

Polishing Operations.	Material Used.	
	Q'ntity.	Nature of Material.
1. Staining		
2. Grainsealer		
3. Sandpaper		
4. Matching and Solution .		
5. Pullover		
6. Touching up		
7. Washing off		
8. Repolishing		

	Fri.	Sat.	Sun.	Mon.	Tues.	Wed.	Thurs.	Total.	
On									
Off									
On									
Off									
Man's No.									
Oper. No.									
Man's No.									
Oper. No.									
Time Taken									
Time Taken									
Only Card			Card to Follow			Last Card			

Foreman's Signature.

Note.—The Card for Cabinet and Chair Departments is similar, but for operations 1 to 8 are substituted : 1. Cabinet Making; 2. Chairmaking; 3. Carving; 4. Filling Up.

entries, provides useful guidance as to whether a particular card is one of a sequence in progress ; the final one of a series ; or the only one concerned with the job named. Cost Office routine is : (a) to check that a full working week has been recorded, (b) to analyse and abstract to provide a running record of work in progress, (c) to summarise under Factory Order Numbers on a Wages Abstract for posting to the Cost Account concerned.

(b) *Methods of Labour Remuneration.* Ordinary time rates are usually paid for work on good-quality furniture, as careful work is to be encouraged.

Straight Piece-Work Rates are sometimes paid in the Upholstery Department.

In the Machine Departments a bonus on output is often adopted, but only when the volume and nature of the work permit long runs for each operation involving few changes in " set-up " of machines such as are necessitated by variations in design. In short, when mass production of standard designs is involved.

The minimum rates payable are governed by the Trade Board regulations formulated for the industry in 1938.

(3) **Factory Overhead Expenses.**—These are carefully allocated, or for some items are apportioned equitably, to each department. Suitable departmental rates of recovery in costs are then determined. The considerations involved are detailed in Chapters XI and XII of *Cost Accounting and Costing Methods*.

The Departments to be considered are :

- (a) Saw-Mill and Machining Department.
- (b) Chair and Cabinet Assembly Department.
- (c) Carving Department.
- (d) Polishing (Spray Finish) Department.
- (e) Polishing (Hand Finish) Department.
- (f) Fittings and Hardware Assembly Department (often referred to as the Filling-Up Department).
- (g) Upholstery (including Upholstery Fabric Cutting) Department.
- (h) Despatch Department.

Saw-Mill and Machining Department. A skilled machinist operates each machine, and an attendant removes the machined parts as they are fed through the machine. Shop labourers keep each machinist supplied with timber parts, using bogie trucks. The machineman unloads and machines ; the attendant removes and stacks the machined parts ready for removal on a Lister-type or other similar truck to the next operation.

Under these conditions it is practicable to include machinist and attendants in the departmental factory overheads, recovery being effected by a machine-hour rate. Although this method

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may be unreliable in some industries, it gives reasonably accurate results for this department.

Alternatively, direct wages may be charged separately by use of Time Sheets or Cards, only factory overheads being recovered by a machine-hour rate, following usual costing practice.

A less accurate method sometimes used is recovery by a percentage on direct wages.

Chair and Cabinet Assembly Department and Carving Department. In these departments the craftsmen's time is the major factor, there being only minor forms of mechanised aids to production, such as electric drills, electric screw-drivers, automatic clamps, and portable electric sand-papering machines. Consequently overheads are recovered by a direct labour-hour rate.

Polishing Department, Spray Finishing. The use of cellulose spray polishing reduces polishing time to minutes, as compared with hours or days required for french polishing by hand. It is convenient and practical to recover the overheads for this department, together with labour and spray materials, as a rate per spray-gun hour (or minute).

Polishing Department, Hand Finishing. French polishing is done by hand. A direct charge is made of polishers' wages and polishing materials. The overheads are charged as a direct labour-hour rate.

Fittings and Hardware Assembly Department. In this department handles, locks, mirrors, bolts, hinges, etc., are fitted. The incidence of overheads is reflected by the extent of labour hours, or wages and overheads are covered satisfactorily by either: (a) a direct labour-hour rate, or (b) a percentage on labour wages.

Upholstery Department. Upholstery is still primarily a skilled handcraft operation, and even common incentives, like piece-work and premium bonus, are little used. It is generally impracticable to maintain labour time records, and it is usual to recover the departmental overheads as a percentage on direct wages.

Despatch Department provides a works service, and may be included in overheads. Sometimes it is regarded as a production department, and the overheads are then recovered as a percentage on packing and despatch wages.

(4) General Administration and Selling Overheads. Segregation of the expenses of administration, selling and distribution is important. Furniture is bulky and fragile, so that transport costs are high. Advertising to the trade and by the manufacturers to the general public in some cases is extensive and costly. It often includes exhibitions. Patterns and shades are expected by the customers for most individual orders. With

selling and distribution costs segregated, the manufacturer can have before him precise information to guide selling policy.

(a) *General Administration Overheads* are recovered in accordance with general practice as a percentage of factory cost.

(b) *Selling and Distribution Overheads* cannot be dealt with in this way, as they are practically unrelated to factory cost. Various aspects of the incidence of these overheads are dealt with on pages 117 and 118 of *Cost Accounting and Costing Methods* (fifth and later editions, and on page 118a of the eighth edition). Special considerations arise in this industry, particularly as regards transport costs.

One of my collaborators, Mr. William Johnston, F.C.W.A., has introduced a method of recovery of these overheads which he has found most valuable in practice. It is a method which might well be applied in a number of other industries. In principle it consists of assessing unit or "points" values to the factors affecting the costs of selling and distribution, thereby dissociating such costs from production costs and selling prices. The practice of charging according to "what the product will bear" is merely an expedient, and not logical costing. It is paradoxical to recover such expenses on factory cost or selling prices alone on, say, a costly and exclusive design when the greatest proportion of advertising expenditure has been devoted to popularising lower-grade mass-produced articles, probably put on the market at "cut" prices.

The "points" method is as follows: For each article "points" are assessed in respect of (a) bulk, (b) fragility, (c) cost, (d) number produced—e.g., whether limited as for an exclusive design. Bulk and fragile nature are material factors in distribution costs. Whether high-grade or cheaper mass-produced lines is important when considering advertising, as already indicated.

Each design produced is given appropriate "points" values. The production for the period involved, usually a year, is then evaluated to obtain a total "points" value as regards selling and distribution. This total divided into the total of selling and distribution costs determines a "points" rate which is used for recovering these expenses on individual designs or articles.

Cost Sheets and Cost Summary.—These are designed to show the cost under each Job Number in four stages, viz.: (1) Frame cost; (2) Upholstering cost; (3) Final Cost Summary; (4) Summary of wood usage at nett finished sizes. For simplicity the forms illustrated show in each case a Unit Cost, eliminating the details of cost totals.

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Frame Cost Sheet.

Customer : A. B. Coy., Ltd., London.

Article : List No. 1000 Easy Chair.

	Qty.	Date : 1 Jan. 19...				Qty.	Date :			
		Rate.	£	s.	d.		Rate.	£	s.	d.
Materials.										
Wood	50	0-2	1	10	8-33					
Waste				15	4-16					
Plywood				4	0-00					
Dowels					10-00					
Screws, Glue				1	0-00					
Castors				1	8-00					
Polish				2	0-00					
			£2	15	6-49					
Labour.										
Machining 1	210	10/-	1	1	6-6					
Making 2	200	5/-		10	0-0					
Carving 3	100	6/-		6	0-0					
Polishing 4	130	2/-		3	0-0					
Fitting-up 5										
			£2	0	6-6					
Factory Overheads.										
Dept. 1	<i>Included in Machine Rate.</i>									
" 2				10	0					
" 3				2	0					
" 4				2	3					
" 5				-	-					
				14	3					
			£5	10	4-09					
Total, Frame Cost										

Note.—The columns repeat for successive weekly costs until the order is completed.
The object of this summary is to give the Frame Cost for control purposes.
When the order is completed the columns are summarised in the Final Cost Summary.

Upholstery Department.

Article : Easy Chair.

Name or Number : 1000.

Sheet No. : 1234.

Items.		Date : 1/1/....			Date :			Date :		
Description.	Qty.	Rate.	s.	d.	Rate.	s.	d.	Rate.	s.	d.
<i>Materials.</i>										
Banding	Yds.									
Buttons	1 Doz.	0.50d.		0.50						
Calico	1 Yds.	10.0		10.00						
Cane	Ft.									
Cord	1 Yds.	4.0		4.00						
Feathers	Lbs.									
Fibre	10 Lbs.		1	0.00						
Gimp	Yds.									
Hair	10 Lbs.	6.0	5	0.00						
Hessian 72"	2 Yds.	1/-	2	0.00						
Hessian 54"	1 Yds.	8d.		8.00						
Linen	Yds.									
Scrim 30"	2 Yds.	8.0	1	4.00						
Springs 3"	4	0.50		2.00						
Springs 4"	4			1.40						
Springs 5"	5	0.30		1.20						
Springs 6"	2	0.45		0.90						
Tacks	5 Ozs.	1.00		5.00						
Thread No. 10	Ozs.									
Thread No. 60	Ozs.									
Twine, Sewing	2 Ozs.	12.00	2	0						
Twine, Spring	2 Ozs.	14.00	2	4						
Wadding	Yds.									
Web	Yds.									
Wire	Ozs.									
Wool	43 Lbs.		3	7						
Cover	4 Yds.	1/-	4	0						
			24	0						
<i>Labour.</i>										
Carding			9	1						
Cutting	5 Min.	1/-		1						
Machine Sewing	10 "	1/-		2						
Hand Sewing	10 "	1/-		2						
Uph. Time or Piece			13	0						
			22	6						
Running Expenses			5	7.5						
<i>Summary.</i>										
Material		1	4	0						
Labour		1	2	6						
Overheads			5	7.5						
		£2	12	1.5						

Note.—Columns repeat for the costs each week until order is completed. Each weekly total is carried to Final Cost Summary.

Final Cost Summary (Front).

Customer : A. B. & Coy., Ltd., London.

Article : No. 1000, Easy Chair.
Cost No.: 405.

No.	Materials.						Labour and Machine Rate.						Expense.				
	Description.	Qty.	Rate.	£	s.	d.	Description.	Hrs. Min.	Rate.	£	s.	d.	Rate.	£	s.	d.	
1	Wood (Details over)			1	10	8-33	Machining	2	10	10/-	1	1	8-0	Incl. in Machine Rate			
2	Waste	50%			15	4-16	Cabinet-making							5/-	10	0-0	
3	Plywood				4	0	Chair-making	2	0	5/-	10	0-0	0-0	2/-	2	0-0	
4	Mouldings						Carving	1	0	0/-	0	0-0	0-0	1/6	2	3-0	
5	Patterns						Polishing	1	30	2/-	3	0-0	0-0				
6	Dowels	50	0-2d.			10	Fitting Up							25%	5	7-5	
7	Screws, Glue				1	0	Uph. Lab. from Sheet No. 1234			1	2	0	0				
8	Bales, Latches																
9	Hookcase Studs																
10	Brass Rims																
11	Brass Rod																
12	Bureau Slides																
13	Castors	1 set	20d.		1	8											
14	Domes																
15	Knutchions																
16	Flush Bolts																
17	Glass																
18	Glass Movements																
19	Handles																
20	Hinges																
21	Hooks																
22	Locks																
23	Pans																
24	Sockets																
25	Stays																
26	Stocks																
27	Umbrella Fittings																
28	Polishing Materials																
29	Uph. Mtls. from Sheet No. 1234			1	4	0											
30	Total Materials			£3	19	0-49											
Total Labour																	
Labour Total (Col. 2)																	
Materials Total (Col. 1)																	
WORKS COST																	
Selling Expense																	
TOTAL COST																	
Profit, 10%																	
£9 10 8-53																	

Cost Sheet (Back).

ABSTRACT OF WOOD USAGE.

Wood List.			Length.		Breadth.		Thk.	Extension.			Extension.			Extension.			Total.
Board No.	Qty.	Part.	Wood.	Ft.	In.	Ft.	In.	Ft.	Ins.	Pts.*	Ft.	Ins.	Pts.*	Ft.	Ins.	Pts.*	
1	2	Front Posts	Birch	1	6	1	0	3	0	0							Total. £1 : 10 : 8.33
2	2	Back Posts	do.	1	6	1	0	3	0	0							
3	2	End Rails	Oak	1	4	1	6	3	0	0							
4	2	Front Rails	Oak	2	0	2	2				1	4	0				
5	4	Side Stretchers	Beech	1	4	3	3				1	4	0				
6	2	Feet	Teak	1	4	1	1	2			0	0	8	1	4	0	
7	2	Back Legs	Birch	2	6	3	3	2	6	0							
8	1	Cross Shape	Birch	2	0	4	4	0	8	0	1	10	6				
9	2	Arms	Oak	1	6	6	6				1	0	0				
10	4	Arm Shapes	Oak	1	6	2	2	9	2	0	5	7	2	1	4	0	
								2s. per super ft.		at	2s. per super ft.		at	1s. per super ft.			£1 : 10 : 8.33
								£0 18 2			£0 11 2.33			£0 1 4			
11	4	Panels (Plywood)	3 m/m Oak	1	0			2s. per sq. ft.		at							£0 : 4 : 0
								4 0 0									

* Note, in timber a part (pts.) is 1½ inch.

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Frame Cost Sheet (page 104) summarises the cost of the wood frame. It is used for control purposes, and in some measure is duplicated in the Final Cost Summary (page 106). The repeat column serves as may be desired for (a) collation of each week's production costs, or (b) comparison of the total costs for each successive Job Order.

Upholstery Department Cost Sheet (page 105) details the cost of upholstery and is self-explanatory. The repeat columns are used as stated in the Frame Cost Sheet.

Final Cost Summary (Front) (page 106) is so framed that the same sheets can be used as an Estimate Summary, and it is for this reason the timber usage is detailed on the back of the summary (page 107) and some of the more general detail of the Wood Frame Cost Summary shown on the front of the form. The Final Cost Summary gives in final form the total cost of producing each unit of production as per the Factory Production Order. For each Factory Production Order two final summaries are prepared, namely :—

- (a) The total cost, summarised from the weekly Upholstery and Frame Cost Sheets.
- (b) The totals calculated as a *Unit Cost* in order to compare with the Unit Standard Cost from which the Unit Selling Price was determined.

CHAPTER XIX

PROCESSING OF YEAST

THE value of yeast for medicinal purposes has been increased greatly in recent years, and the production of yeast has correspondingly tended to increase.

Two main methods of production are in use. The older and less productive was allied to the distillation of whisky from barley to which in the early days it was regarded as an ancillary operation. The growth of demand, together with the competition from foreign markets, has resulted in the more modern and more productive Danish method of processing being adopted.

Production takes two main forms :

- (a) Wet yeast, commonly termed baker's yeast.
- (b) Dried yeast.

It is the dried yeast which is being developed for medicinal purposes (generally in tablet form) and in some cases it is vitamised with successful results.

Production Procedure.—Briefly the method of processing depends in origin on the production each week in the laboratory of a small quantity of live yeast cells which multiply rapidly. By the addition of molasses, and continuous processing, the product is finally produced in wet form something like butter in substance. Hence the term wet yeast to describe the yeast at this stage used in the baking industry.

If the yeast is to be dried, it is broken up and stoved for the requisite period of time. When dry, it is in the form of small, hard flakes, and if the yeast is to be finally sold in tablets, the dried flakes are ground down into fine powder and subsequently compressed in tablet-making machines.

Method of Costing.—The processing lends itself conveniently to the unit method of costing. Costs are determined at short intervals, generally weekly or four-weekly.

The unit of cost for wet yeast is the pound weight, or a hundredweight (cwt.).

The unit for the dried yeast in tablet form is a thousand tablets, or a kilogram of bulk tablets prior to packing in small containers, when the unit becomes (say) 100, 500 or 1000.

Procedure.—(a) *Materials.* The materials used are largely individual to each plant, but for Stores Control no special problems arise. The physical storage of chemicals presents its own difficulties, and control of leakages, deterioration, etc., is carefully accounted. The total quantity and value of all materials and

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chemicals chargeable directly to production in the period—weekly or monthly—are carried to the Cost Summary via the usual channels of the Materials Requisition Note, the Stores Issued Note and the Stores Ledger. Special care is taken of chemicals, both as regards skilled control and suitability of containers and housing.

The charges for issues to production are summarised on Materials Abstracts in the normal manner.

Labour. There are no specific rates of wages laid down for this industry by either Trade Board or Trade Union Agreement. The processing is so fundamentally dependent on natural or induced chemical reaction that payment by results is impractical. In consequence, hourly rates of wages are generally the basis of payment. Each stage of the processing is controlled by highly skilled technical staff with supporting unskilled labour.

Job Cards are not generally required, and the charging of Wages and Salaries in totals to each week's processing is a comparatively simple matter. Where different types of packing or containers are used it is usual to allocate labour costs to each type of pack, which necessitates the analysis of wages in the Packing Department.

Factory Overheads.—The unit of production—e.g., lb. or cwt.—of yeast is the basis of recovery of Overhead Expenses for Factory Charges, Administration Expenses and Selling and Distribution Expenses. It follows, therefore, that it is necessary to distinguish clearly between Fixed and Variable Expenditure. The financial records are specially drawn up to emphasise the distinction. Generally the processing capacity of such a plant as that under consideration is greater than day-to-day processing, and production beyond normal has a marked downward influence on production costs.

Normally production overheads are estimated on the basis of the previous year's trading accounts adjusted for trend of production. Special care has to be taken in the calculation of the target production on which the recovery of Overhead Charges is to be made. Policy and trend will determine the target figure.

Depreciation of Plant and Obsolescence. Depreciation of chemical plant as is used in the production of yeast requires special consideration, as different rates arise as between certain sections of the plant. Such rates may vary from 2% on almost indestructible plant to 20% or 30% on specially fragile plant. The Plant Register is therefore carefully classified, so that the depreciation for each type may be ascertained for inclusion in the costs.

The Weekly Cost Summary comprises the actual prime cost of materials and labour, and the computed overheads based on

pre-calculated rates per lb. to recover fixed and variable expenses. The Weekly Cost Summary illustrated on pages 112 and 113 shows the cost of production in two stages :—

1. The costs allocated by direct analysis from financial records on production of WET yeast and the reduction of the totals to a cost per lb. WET yeast produced (columns 1 and 2).

2. The further costs allocated by direct analysis from financial records on the drying of the wet yeast to form DRIED yeast and the reduction of the totals to a cost per lb. DRIED yeast produced (columns 3 to 6).

The illustration includes additional columns to show the total expenditure to date from the commencement of the trading period, and the extended cumulative totals reduced to show the cost per lb. of WET and DRIED yeast to date, as shown in the continuation of the form on page 113.

The further comparison of Weekly Cost Summaries grouped into smaller periods, *e.g.*, monthly, is a simple matter.

For final control purposes the Cost Statement compares in the last two columns the total Overhead Charges recovered on production to date with the actual expenditure on such charges extracted from the financial books. In the calculation of the actual expenditure it is necessary to provide for accrued and pre-paid charges—*e.g.*, Rents, Rates and Insurance. With this information (see last two columns on page 113) decision as to the desirability of adjusting expense recovery rates may be made as required periodically.

The Summary illustrated shows for simplicity the complete processing of the total production of yeast to the dried form, but in practice, since yeast will be sold in both WET and DRIED form, separate summaries may be made for WET and DRIED yeast: the cost per lb. of WET yeast being the unit brought forward to the Dried Yeast Summary.

Where the dried yeast is broken down into powder and prepared in final tablet form, a further Cost Summary for the process of tableting is necessary, and is generally embodied in the Weekly Cost Summary, sharing the progressive cost from wet to dried yeast and from dried yeast to yeast tablets.

Statement of Cost for Production of Yeast.

Week ending 31st May, 194.... 20th Week.								
Production : Yeast, Wet	50,000 lb.							
Yield : Yeast, Dried	25,000 "							
Prime Costs at actual. Overhead Charges per Calculated Rates.	(1)		(2)	(3)		(4)	(5)	
	Yeast, Wet.		Cost per Lb. Yeast, Wet.	Drying of Wet Yeast.		Cost per Lb. Dried Yeast.	Total Cost on Produc- tion Dried Yeast.	
	£	£	Pence.	£	£	Pence.	£	£
Materials :								
Molasses	150						150	
Chemicals	50						50	
Special Chemicals	1000	1200	5-16				1000	1200
Labour :								
Wages	20			10			30	
Salaries	80	100	0-48	40	50	0-48	120	150
Conversion :								
Steam, including Fuel	15			10			25	
Electricity	5						5	
Water	5			5			10	
Air	100			20			120	
Maintenance	20	145	0-70	5	40	0-42	25	185
Factory and Administration Charges :								
Fixed Charges at 0-50d. per lb.	110			55			165	
Variable Charges at 0-25d. per lb.	55	165	0-75	27	82	0-75	82	247
Total Cost Naked	1610	1610	7-09	172	172	1-65	1782	1782
Packing Materials	100			210			210	
Do. Labour	50	160	0-72	100	310	2-98	100	310
Total Cost in Containers	1760	1760	8-81	482	482	4-63	2092	2092
Cost per Lb. Wet Yeast :								
Naked			7-09 pence					
Packed			8-81 pence					
Dried Yeast :								
Naked								15-83 pence
Packed								18-81 pence

(Continued on opposite page.)

Cumulative Statement of Cost of Production of Yeast.

(Continuation from opposite page.)

Being Total for 20 Weeks ending 31st May, 194....									Comparison of Recovered and Actual Overheads.	
Wet yeast . . . 1,000,000 lb. Dried yeast . . . 500,000 „										
Yeast, Wet.		Cost per Lb. Yeast, Wet.	Drying of Wet Yeast.		Cost per Lb. Dried Yeast.	Total Cost on Production Dried Yeast.		Total Cost per Lb. Dried Yeast.	Total Overhead Charges Recovered to Date.	Total Expendi- ture per Financial Accounts to Date.
£	£	Pence.	£	£	Pence.	£	£	Pence.	£	£
3,000						3,000				
1,000						1,000				
9,000	13,000	3-12				9,000	13,000	6-24		
400			400			800				
2,000	2,400	0-58	1,800	2,200	1-06	3,800	4,600	2-21		
300			400			700				
200			110			310				
150			115			265				
1,000			425			1,425				
200	1,850	0-44	150	1,200	0-58	350	3,050	1-47		
2,200			1,100			3,300			3,300	2,750
1,100	3,300	0-75	550	1,650	0-79	1,650	4,950	2-37	1,650	1,400
20,550	20,550	4-89	5,050	5,050	2-43	25,600	25,600	12-29	4,950	4,150
3,000			5,500			5,500				
1,450	4,450	1-07	2,500	8,000	3-84	2,500	8,000	3-84		
25,000	25,000	5-96	13,050	13,050	6-27	33,600	33,600	16-13		
		4-89 pence 5-96 pence						12-29 pence 16-13 pence		

CHAPTER XX

COOKED-MEAT PRODUCTS

VARIOUS forms of cooked meats, and vegetables with gravy stock, are preserved in tin or glass containers, and the manufacturing operations involve preparation wastages, and also varying quantities of by-products or residuals, the values of which differ considerably. These factors introduce somewhat complex costing problems.

Meat received is placed in refrigerator cold stores for short periods, during which some loss in weight occurs. On issue to the Butchering Department experienced butchers "bone-out" and prepare the meat for the production line. Separate receptacles are provided for each type of rejection—*e.g.*, bones, fat, rinds, offal of various kinds. It will be apparent that weight losses arise in this operation due to blood loss, thawing, and knife adherence.

The prepared meat is transferred to the Filling Department. The specified weights or volume of ingredients are filled into the cans, which are counted automatically, as they are again when the sealed cans leave the sealing machines for conveyance to the cooking retorts. Subsequent operations include labelling and packing the cans in cartons or cases.

Method of Costing.—Process costing is suitable. The diversity of materials, residuals and wastages make single unit costing unreliable, unless only one type of product is handled, which is not probable. The units of cost are usually 100 or 1000 cans, although occasionally a cwt. or gallon unit is used.

Procedure for Costing.—*Ingredients and Materials.* The weights *received* into cold store are recorded on Goods Received Notes and debited in the Stores Ledger Account for each variety of ingredient. The received weights are usually different from those invoiced, owing to partial thaw and drip during transportation, for which allowances are made. Issues will be dealt with by usual issue requisition procedure. The percentage loss in weight experienced in cold store from period to period may be added to the issued cost; alternatively, an overall rate per lb. may be calculated on the formula:

$$\frac{\text{Total loss value for costing period}}{\text{Total weight from store in the period}}$$

In the Butchering Department weights are recorded for bones, fat, rinds, and each kind of offal.

After preparation a check weight is taken of the prepared meat. The difference in weight between that issued to the butchers and the sum of the prepared meat and residuals represents the loss due to blood loss, thawing, knife adherence, etc. Close check on all these weights is necessary to control efficiency.

The specification for the meat ingredients of the content of tins or jars has a direct bearing on the weight and value of residuals, which vary considerably. Thus, excess fatness of meat may have to be removed. If this fat can be used in other products, such as sausages or potted meats, it has a higher value than if it has to be sold for soap-making, etc. Similarly for offals.

Control of Meat and Usages. (a) Where each issue of meat from the cold store can be completely segregated, precision in weights, etc., may be obtained by the use of a "Meat Control Card", which follows the meat from time of issue to the final package. A simple form is shown below :—

Meat Control Card.

No.:

Order No.: PK 107. Beef Steak in Gravy. 1 lb. Cans (9 oz. Beef per can).

COLD STORE ISSUE: Date: 4/1/...

Requisition: 402.

	Lbs.	Total, lbs.	Cans Filled.	Weight, lbs.	Cans.
10 Hind Ox Quarters . . .	890	2300	From butchers . . .	1455	2512
20 Fore Ox " . . .	1410		Cans filled . . .	1413	
BUTCHERING:			Specification weight . . .	1413	
Bones . . .	584		Loss in filling (2.89%) . . .	42	
Excess fat . . .	101		(drip, down scale, etc.)		
Suet . . .	60		Filled cans rejected:		
Other residuals:—			Laboratory tests . . .	5	11
Skin . . .	5		Blown, etc. . .	6	
Beef to line . . .	1455	2205			
Loss on butchering (4.13%) . . .		95	Total Cans to Warehouse . . .		2501

This form gives full information as to raw weights and emerging prepared weights. The filled cans contain the specified weight content of meat when filled, and the difference between number filled at this weight, deducted from the weight from the butchers, reveals the loss in filling, which, being "unseen", can be determined only in this way. Some filled cans are sent to laboratory for testing, others are rejected for faulty sealing, etc., and the balance, as shown by the card above, pass to the warehouse.

(b) Where the segregation of each issue is impracticable or inconvenient, the issues as per issue requisitions can be detailed on a Summary Card, and from Report Sheets the various weights d. It with on the various packing lines can be transferred to appropriate columns on the Summary Card representing the

usages in each department or packing line. The use of code letters facilitates reference in such statistics—*e.g.*, P K, preserved meat kitchen; S K, soup kitchen; P M K, potted meat kitchen; S G K, sausage kitchen, and so on.

Both the above Control Records provide information necessary to the buyer (who is responsible for the qualities of meat supplied), and to the production manager or foreman, who needs to keep a close watch on the extent of unseen losses in canning, and on rejections due to faulty seaming. The last-named losses can be kept to a minimum by prompt and regular attention by the Maintenance Department.

These records also serve for entering up the Stores Ledger Control Accounts as to quantities. Values are then inserted and extended for both raw meat and residuals. With these and other records the departmental Cost Accounts can be prepared. An example of a departmental account for meat preparation is given on page 118. Similar entries to those shown are made for the remainder of the Cost period when the average cost per lb. of prepared beef may be transferred to the appropriate cost sheets as example on page 118. It will be noted that the prepared cost may vary, sometimes considerably, dependent upon the meat supplies available, *e.g.*, the issues of January 5th comprised a larger proportion of the more expensive meat than did those of the previous day. Where possible stores issues will be controlled to eliminate or reduce this discrepancy, but the example shows the danger of costing on isolated issues or for that matter on too short a costing period.

It is useful to keep a detailed schedule of the residuals in weight and value, the total value of which is transferred to the credit of the preparation account. A form as given for vegetables on page 128 would be suitable.

The procedure so far outlined concerns the type of production in which all the prepared meat is used for a common finished product, but sometimes this is not the case. An example is production usage of chickens.

These are bought and received as a complete bird, but on preparation separate use is made of:—

(a) Breast meat: the best part, of high value, used for choice packings.

(b) Legs: used in production of canned roast fowl for export.

(c) Trimmings: used as garnish for chicken soup, galantine, etc.

(d) Bones, giblets, etc.: for the production of broth.

(e) Unusable heads and feet.

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Meat Preparation Department Account.						BEEF.							Cr.
Dr.	19....	Issues.	I.R. No.	Total for Batch.	Cumulative Total for Cost Period.	19....	Prepared.	S.R. No.	Lbs.				Per Lb. Pre- pared.
				£ s. d.	£ s. d.				£	s.	d.		
Jan. 4	890 lbs. at 7·55d. lb. 1410 lbs. at 6d. lb. . Cold Storage at 0·391d. lb. . . . Butchers : Direct Labour . Fixed Charges .			28 0 0 35 5 0 3 15 0 5 1 8 2 0 4		Jan. 4	Residuals per Summary . Loss . Prepared Meat to P.K. Dept.		750 95 1455	5 — 69	1 — 0	5 — 7	d. 11·386
									2300	74	2	0	
Jan. 5	1600 lbs. at 8d. lb. . 720 lbs. at 6d. lb. Cold Storage at 0·4d. lb. . . . Butchers : Direct Labour . Fixed Charges .			53 6 8 18 0 0 3 17 4 5 11 6 2 0 8		Jan. 5	Residuals per Summary . Loss . Prepared Meat : To P.M.K. Dept. . To P.K. Dept. .		774 86 730 730 2320	5 — 38 38 £82	12 — 12 12 16	2 — 0 0 2	 12·690 12·690

The values attributed in costing must be determined by marketing considerations. The same considerations, but on a more important scale, apply to the use of pigs in the industry, of which it is claimed that "everything can be used except the squeak".

Control of Vegetables Used.—In many canned-meat preparations vegetables form part of the ingredients. Similar procedure is often adopted. A "Vegetable Preparation Account" is debited with the bought-in cost, and also any cartage inwards involved. Other debits include stores charge, direct labour of preparing, and the labour-hour charge for recovery of overheads of the department. There is usually some credit receivable for trimmings. The Weight Control Card Reports enable the losses in preparation to be ascertained, and provide the basis for charging of prepared vegetables to the production lines. It will be apparent that losses often increase as the "season" advances.

When Standard Costs are used due allowance for seasonal variation must be carefully applied.

Cans, Labels and Finishing Supplies.—The issues to the production line and finishing in the Packing Department are charged out as required for the period. Relatively small losses on cans are revealed as the cans are served to the production line; others when sealing takes place; and finally after the filled cans have been held for an "incubation" period, during which "blown" cans are disclosed. Whilst it is possible to record actual quantities under these headings and charge as such to the Cost Account for the order or cost period involved, it is more usual and satisfactory to keep daily statistics under each heading of fault, and to determine percentages or a rate per 100 or per 1000 cans based on quarterly or longer periods. The charge so ascertained is then applied in the Cost Account or Cost Sheet for each production order, or cost period.

This method is satisfactory for labels and other sundries.

Filling and Finishing Line Checks are desirable either by batches or for daily periods. This provides the data for checking theoretical weights against actual. Thus, if each tin is required to contain 4 oz. of prepared meat, an output of 4000 tins should contain 1000 lbs. of meat. The actual weight will show a shortage as against the quantity passed to the Filling Line. The difference is recorded, and represents blood drip, spoilage (e.g., by dropping on the floor, etc.), and "down-beam" (or turn of scale) loss as against theoretical. A daily return of all weights is important not only for costing, but also to verify that the average content complies with the declared or specified content.

Tins or jars are counted automatically as issued to the Filling Line. The count of the filled tins reveals any difference, which will be due to damaged or faulty tins or jars.

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Similarly, the check on the quantities passed on inspection after coming from the retorts provides the data for retort losses.

Labour.—This type of production lends itself to mass-production methods. Piece rates are usually paid to the butchers. In the filling and finishing processes piece rates or collective piece rates may be paid, although a premium bonus system is used with advantage.

The labour operating the steam cooking retorts is usually paid weekly time wages, owing to the varying times of cooking for different packs and products. In order to charge each type of product, the wages can be (a) resolved into a labour wage cost per unit calculated on a ratio basis for each size and type of product; or by assessing a "points" value for each line manufactured or, (b) computed on a retort-hour rate. This method has directness, in that if the time in cooking is recorded, an accurate total cost for each size or type is obtained, and by dividing by the output for the period of production of that line the unit cost is established.

The record of direct labour wages and time is obtained from Time Sheets or Clock Cards for operators engaged on each process.

Factory Overhead Expenses.—If overhead expenses are apportioned to departments or processes on the lines indicated in *Cost Accounting and Costing Methods*, Chapter XI, a rate per unit of output in each process can be established if a single product is made. Where numerous different products are involved, this method cannot be used.

In the Butchering and Preparation Department a labour-hour rate is reasonably accurate, and for meat preparation a weight rate is often used, and is fairly reliable if animal meat only is concerned.

The overheads for the Filling Line present problems similar to those for vegetable and fruit canning, and reference should be made to pages 32 and 33 of this book.

The overheads for the cooking retorts will be applied as a retort hour rate.

Administration Overheads are calculated as a percentage on works cost.

Cost Sheet.—A separate Cost Sheet is prepared for each product, and, if production for a product extends over a long period, a Cost Sheet is prepared weekly (or other convenient accounting period). Alternatively, a Cost Sheet is prepared for each batch of a particular line. An example is given on page 121.

COOKED-MEAT PRODUCTS

121

Cost Sheet.

Canned Meat and Vegetables.

Cost Period No. : 3

Output : 9972 Cans.

				£	s.	d.	Per 100 Cans, pence.
Ingredients.							
	lb.						
Prepared Beef	3,750 at process cost	11.312d. (see note (ii))		176	15	0	
do. Potatoes	2,500 at	1.014d.		10	11	3	
do. Carrots	1,250 at	2.480d.		12	18	4	
do. Peas	1,250 at	7.500d.		39	1	3	
Sundries for gravy :							
Salt							
Pepper							
(Other items in detail)	1,250			15	19	2	
	<u>10,000</u>			<u>255</u>	<u>5</u>	<u>0</u>	<u>612.600</u>
Yield.							
Specification	10,000						
Actual, gross	10,008						
do. nett	9,972			255	5	0	614.320
Wastage (samples faulty, etc.)	<u>36</u>						
Labour (subsequent to preparation) :				£	s.	d.	
Direct labour on production line (filling and closing cans)				9	19	6	
Retort house (processing)				1	8	0	
Finishing (examine, clean, label, pack into outer containers, etc.)				10	4	6	
Warehouse and despatch				1	19	0	
				23	11	0	56.679
Packing Supplies.							
Cans (1 lb. lacquered in, plain out) :							
Filled cans (10,008)				56	0	0	
Damaged cans (see footnote (i)) (80)							
Labels				1	0	10	
Lacquer				5	15	4	
Cartons (each 24 cans)				15	0	0	
Sundries				2	4	4	
				80	0	6	192.589
Overhead Expenses (excluding preparation).							
Factory : Canning 100% on labour				20	4	0	
Retorts 250% on labour				3	10	0	
				23	14	0	57.040
Factory Cost							
Administration at 5% on factory cost				19	12	6	382.10.6
Selling at 10% on selling price				58	3	4	
Distribution at scale for the product				10	13	2	
				87	19	0	211.672
Total Cost				<u>470</u>	<u>9</u>	<u>6</u>	<u>1132.310</u>

Note (i).—With regard to spoilage of cans, labels, etc., which occurs in handling before or during the filling operation, in the example, the actual experience of the loss is applied. This method may be considered unfair, and it is suggested, as an alternative, that where reliable statistics are available, a calculated addition by way of a percentage or charge per 100 cans is made to cover this loss. This addition should in each case be shown as a separate item rather than an adjustment to the quoted price.

(ii) The price per lb. is determined from the Meat Preparation Account for the cost period No. 3. An example of this account is on page 118. The other prepared ingredients are similarly ascertained.

CHAPTER XXI

MANUFACTURE OF SAUSAGES

A SURVEY of this industry from the live pig to the finished product falls into well-defined cost processes.

A. Receipt and handling of live pigs to the slaughter-house.

B. Slaughtering, veterinary examination and preparation of the carcass (draining, bristle recovery, etc.).

• Carcasses are suspended in store maintained at a low and uniform temperature by thermostatic control.

C. Examination of the carcasses and removal of bruised flesh. This operation is often performed during the storage stage.

D. Butchering, cutting up into joints, at the same time recovering all offal, and removal, where appropriate, of bones, rind, excess fat, etc. Separate bins or trays are provided for each kind of residual.

The Cost Accountant's responsibility for a close scrutiny of the weights of the various residuals, their valuation and transfer of weights and appropriate values to the Process Cost Accounts for the various departments or shops, is of great importance, as it provides valuable information for cost and production control by the manager.

E. Bulk manufacture, which consists of mixing the prepared meat with the filling material (bread, rusk, etc.) and seasoning, etc., to the specified recipe, and grinding the mass by power-driven plant. This ground mass is collected in large containers for transfer to the filling operation.

F. Filling into casings (skins) and linking (tying). The ground mass is filled into hoppers and forced through tubal apertures into the casings fitted on to the tubes by the filling operators.

G. Packing. This may be (1) the simple procedure of wrapping in wax wrappers, banding with printed labels, or (2) filling into tins or other container.

H. Preserving (cooking) process, where applicable, as in (2) above.

I. Examination of tins for rejects, general finishing, labelling, etc., and packing into outer containers ready for warehouse and dispatch.

It is usually practical to segregate the various operations named, and the costs for each process are therefore reasonably

Pork Butchering Cost (Sch. A).

Period 3rd to 7th January, 19.....

				22,780 lb.			Per lb.
				£	s.	d.	pence.
Carcases received	280 = 30,576	lb. at transfer cost		£	s.	d.	
Less Residuals:	lb.			12	10	0	
Bones	2105	at 25s. cwt.		23	9	10	
Fat (surplus)	1032	at 8d. lb.		34	8	0	
Rinds	1472	at 3d. lb.		18	8	0	
Heads	2234	at 18s. cwt.		17	19	0	
Feet	410	at 9s. cwt.		1	12	11	
Kidneys	76	at 11d. lb.		3	9	8	
		7,329			29	7	5
		23,247					
Out pork to sausage kitchen		22,780			11	10	18
Loss		467					
Add Butchers' Wages				50	8	7	0-5313
do. Fixed Charge				11	5	0	0-1186
				£1172	12	2	12-3541

Cost per lb. cut pork : 12-3541 pence.

Sausage Preparation Cost (Sch. B).

Week ending :

				49,760 lb.			Per lb.
				£	s.	d.	pence
Cut Pork used	21,053	lb. at transfer cost, 12-3541d. lb. (per Sch. A)		1083	14	3	
Bread (soaked)	21,474	at process cost		141	18	0	
Cereal	3,560	at 30s. cwt.		47	13	8	
Seasoning	1,210	at 8d. lb.		40	6	8	
Water	3,500						
		50,797					
Skins	730	bundles at 8s. bundle		1313	12	7	6-3358
				292	0	0	1-4084
Direct Labour				1605	12	7	7-7442
Preparation Dept. Overhead Charges, 75% of labour				44	8	4	0-2142
				33	6	3	0-1607
				£1683	7	2	8-1191

Yield : 49,760 lb.

Sausage Packing Cost (1-lb. Tins).

Week ending :

				Sound Tins, 49,572.			Per Dozen 1-lb. Tins.
				£	s.	d.	pence.
Sausages brt. down, 49,760 lb. (per Sch. B)				1683	7	2	97-7986
Tins at 12s. 3d. gross, 50,010 (including wastage)				212	14	4	12-3583
Labour : filling and closing tins				48	12	6	2-8250
Filling Department Overhead Charge, 80% of labour				38	18	0	2-2800
				1983	12	0	115-2419
Retort House Charges, 49 retort hours at 5s. 7d. per hour				13	13	7	0-7947
				£1997	5	7	116-0366

Yield .. : : : 49,764 1-lb. tins.
Less : : : 182 faulty tins.

49,572 sound tins.

Note.—6 lb. processed meat lost in filling the tins.

simple—for example, the slaughter-house cost can be computed periodically on the formula

$$\frac{\text{Total Cost of the slaughter house, including its overhead apportionment}}{\text{Total weight in lbs. of prepared carcass handled}}$$

giving a cost per 100 lb. (or per cwt. if preferred) of prepared carcass which is the basis to be applied in the next operation.

The costs of the various prepared materials are computed on similar bases to those shown in the text for cooked-meat preparations as described in Chapter XX, pages 116 and 118.

A Cost Sheet will be prepared for each costing period, which should be at short intervals with a seasonal cumulation, a typical example of which appears in three sections on page 124.

CHAPTER XXII

PRODUCTION AND CANNING OF SOUPS

THE many varieties of soups which are canned commercially can be classified into three categories: (a) Vegetable and Meat, (b) Clear and (c) Cream Soups.

The production operations fall into two main sections—namely, (a) Preparation and Cooking, (b) Filling, Sterilising, Capping and Packing Cans. Large canners may also make their own cans and packing-cases, and these departments will be subject to separate costing procedure.

Method of Costing.—Owing to variable factors in the preparation department, the costs up to this stage may be dealt with by a Batch Costing Method, introducing actual weights and costs for each batch prepared. The use of “ingredients’ preparation accounts” as described in Chapter XX, pages 116 and 118, is, however, more practical. The filling and other operations are conveniently dealt with by the Unit Output Method.

Procedure.—*Materials* for use as ingredients consist chiefly of vegetables, meats, poultry, cereals, spices and herbs. To avoid much detailed clerical repetition, the storekeeper is supplied with a list of recipes of each variety of soup, stating the quantities required per batch of those ingredients not passing through the Preparation Departments. The requisition can then be issued simply as “Ingredients for ‘x’ batches of . . . Soup.” The stock clerk can then calculate the quantities and issue them. The recipe quantities take into account usual wastage figures, based on data supplied by the Soup Preparation Department, which is checked regularly with records made period by period. The losses by waste and preparation of materials dealt with in the Preparation Departments are absorbed in the “Preparation Account” referred to above. The accounts for two vegetables are shown on page 129. One shows a loss in process, the other a gain.

The costs for ingredients are calculated from the Stock Ledger records. Credit is given for vegetable waste, and residual value of bones and fat, in the “Preparation Accounts”. It is useful for control purposes to prepare a summary of losses, a suggested form being shown on page 128.

Ultimate yield of filled cans is recorded and reported by the Filling Department, the figures being then entered on the various Control Cards. An example is shown on page 116.

Labour. Separate records of time and wages of direct labour are made for each type of soup, separate summaries being made for ingredient preparation and cooking. At the filling stage there is no need for analysis, as the labour engaged on filling and sterilising is the same and continuous for all types of soup. The direct labour is apportioned according to the number of cans of each variety produced. For this purpose various sizes of cans are brought to a common unit equivalent on a “ points ” or ratio basis, which is easily determined by practical tests. It will be apparent that a can of, say, double the standard size does not involve twice the labour time, hence the necessity of time study check on the filling times for each size to establish ratios.

Summary of Vegetable Waste Sales.

Production Period :

Vegetable.	Usage.	Waste.	% of Waste.	Amount Un-saleable.	Amount Available for Sale.	Sale Value.		
	Lbs.	Lbs.		Lbs.	Lbs.	£	s.	d.
Potatoes	55,000	22,000	40	1,100	20,900	2	6	8
Carrots	15,000	4,500	30	225	4,275		9	7
Peas	5,000	500	10	25	475		1	1
Beans	5,000	250	5	15	235			6
Turnips	15,000	3,750	25	185	3,565		7	11
Total	95,000	31,000	32.6	1,550	29,450	£3	5	9

Indirect labour of shop supervision, cleaning, labouring, etc., is often applied as a percentage on direct labour in the sections concerned.

Packages (Cans, Cartons, Cases).—The usage and cost of cans, and records of rejected cans, before and after filling, are necessary. The procedure has been described in the chapter dealing with Canned Fruits and Vegetables (*q.v.* page 32).

Can-making costs may be obtained with suitable adaptation by the method described for drum-making (*q.v.* Chapter III).

The procedure for wood-case-making costing is described in Chapter XVII dealing with wood-case manufacture. It should be noted, however, that “ shocks ” of cases may be purchased, and assembly costs only are then involved.

Factory Overhead Expenses.—The usual methods of apportionment of factory overheads, as described in Chapters IX to XII of *Cost Accounting and Costing Methods*, should be used to obtain the totals recoverable over production in each department, viz. : (i) Preparation, (ii) Cooking, (iii) Filling, (iv) Packing.

The recovery rates for departments (i) and (ii) should be labour-hour rates, but as the labour consists of reasonably uniform types, a percentage on direct wages may be used instead. For

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the filling line a unit rate per dozen cans may be adopted, if necessary converting varying sizes to an equivalent standard. Alternatively, a team-hour rate may be used.

Reconciliation by means of Cost Control Accounts should be effected to establish the accuracy of the costs in each costing period. Illustrations and procedure are given in Chapter XV of *Cost Accounting and Costing Methods*.

Cost Sheet.—A separate Cost Sheet is prepared for each variety of soup, and for each costing period. A specimen is illustrated on page 131.

Sectional summaries and abstracts, which contain details of the totals introduced into the Cost Sheet, are prepared from the returns and cost data, and are reconciled with the Stock and Financial Control Accounts.

Thick Vegetable (with Meat) Soup in A2½ Cans. Cost Sheet.

Cost period

Batches made 100

Total cans filled 4,000 doz.

Yield per batch 40 doz. cans.

	Quantity.	Total Cost.			Cost per Batch.			Cost per Dozen Cans.	
	Lbs.	£	s.	d.	£	s.	d.	s.	d.
1. <i>Ingredients.</i>									
Prepared Potatoes ex Preparation Account	33,000	107	5	0	1	1	6		6-435
" Carrots " " "	12,000	84	15	0		16	11		5-085
" Beans " " "	12,000	83	0	0		16	7		4-980
Meat (boneless) " " "	13,000	416	13	4	4	3	4	2	1-000
Sauce		31	13	4		6	4		1-900
2. <i>Labour.</i>		723	6	8	7	4	8	3	7-40
Preparation		33	6	8		6	8		2
Manufacturing		66	13	4		13	4		4
Filling, sterilizing, etc.		83	6	8		16	8		5
3. <i>Packages.</i>		906	13	4	9	1	4	4	6-4
4000 doz. Cans at 20s. gross	£ s. d. 333 6 8								
+ 1% waste	3 6 8								
4000 doz. Labels at 5s. per 1000	12 0 0	336	13	4	3	7	4	1	8-2
+ 2% waste	4 10								
2000 Containers, fibreboard, at 800s. per 1000	12 4 10					2	5-5		0-74
+ ½% waste	80 0 0								
	8 0								
Sundry packing materials.		80	8	0		16	1		4-82
4. <i>Factory Overheads</i>		50	0	0		10	0		3
		150	0	0	1	10	0		9
5. <i>Administrative Overheads</i>		1535	19	6	15	7	2-5	7	8-16
		100	0	0	1	0	0		6
6. <i>Selling and Distribution Expenses</i>		1635	19	6	16	7	2-5	8	2-16
		66	13	4		13	4		4
TOTAL COST		£1702	12	10	£17	0	6-5	8	6-16

CHAPTER XXIII

BISCUIT-MAKING (PLAIN BISCUITS)

THE great volume of biscuits produced annually necessitates the use of automatic and semi-automatic plant operated on mass-production lines. There are two main types of plant used for the manufacture of biscuits for human consumption :—

(i) *The Pan Chain Oven*, so called because of the use of “pans” or trays upon which the biscuits pass through the ovens.

(ii) *The Automatic Band Plant*, which is a self-contained unit of rollers, brakes, cutters and cooler.

The output of a 50-ft. three-pan chain oven is 5 to 6 cwt. per hour, whilst the output of a 150-ft. automatic band plant is about 8 to 9 cwt. per hour. A much greater amount of hand labour is required for the pan chain method.

Manufacturing Procedure (Plain Biscuits) : (i) *Automatic Band Plant*.—The ingredients appropriate to a batch are filled into mixing tubs or containers, which are fitted with wheels. This filled tub is then placed in position under the mixing plant. The mixer is lowered into the tub, and two pairs of rotary mixing arms revolve in opposite directions, thereby thoroughly mixing the ingredients to form the dough. The tub of dough is then wheeled to the plant by hand, and the dough is passed through rollers set to give it the required thickness. In this state the layer of dough will either (a) pass under the cutters, which stamp out the shape of the biscuit prior to baking, or (b) it will pass along to the “brakes,” which fold back the layer of dough, causing it to be re-rolled. All hard dough biscuits are braked in this way, the object being to produce a layer-like effect. In the case of “puff” biscuits, fat is introduced between the folds made during the braking process, thereby producing a flaky biscuit when baked. All other soft dough biscuits pass through the rollers and cutters directly to the oven.

Upon leaving the cutters the small dough shapes are taken up automatically by the conveyor band, which travels at an appropriate speed through the oven. The oven is heated by gas, the supply being regulated by series of numerous taps—namely, one main oven tap, and three groups of many sectional control taps which control separately the top and bottom portions of the

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sub-sections of the oven. The use and regulation of the oven heat are most important factors. Various types of biscuits require different oven conditions. Thus, for example, "cream crackers" require a speedy passage through the oven at maximum heat throughout; whilst the "digestive" and similar biscuits require slow baking with changing temperatures at different points of the oven.

On emerging from the ovens, the biscuits pass through a cooling chamber. This may be a continuation of the oven unit, or in other types of plant the biscuits drop from the oven band on to another moving in the opposite direction and passing below a cooling chamber below the oven.

The cooked biscuits emerge in the packing department. There a mechanical stacking device comes into play as the biscuits leave the cooling chamber. This stacker consists of a series of grooves extending the width of the band. The grooves cause the biscuits to stack on their edges, owing to the movement of the band, so that the packing operatives can easily and rapidly take hold of the stacks and fill into the tins with minimum effort.

(ii) *Pan-Chain Oven*.—After the dough has been made and rolled, the shaped dough pieces pass from the cutters on to trays. The trays are then placed on a moving conveyor chain passing through the oven. The series of heat controls is similar to that already described. When the trays of baked biscuits emerge, they are transferred to racks for cooling. The trays are emptied on to a stacker, and then passed back to be refilled. The labour required is considerably greater for this kind of plant.

In both the above plants the flour and other ingredients are dealt with in batches of regular size. The quantities per batch are weighed out, in accordance with the appropriate recipe, in a dry state.

The speed and heat vary according to the thickness of the biscuit, the moisture content desired on completion of baking, and to a lesser extent on the variety of biscuit.

In modern factories there are special refinements incorporated in the plant. For example, when the dough has passed through the cutters, the trimming surplus is collected by means of a belt, and passed back for re-rolling, together with any imperfectly shaped dough pieces. There may be also an overhead conveyor system for biscuit tins, linked between the store and the packing belt. The action is continuous and the packers remove a tin for filling, and, when filled, replace the tin on the conveyor. Further along, the filled tins are checked and removed by the workers in the Despatch Department. The conveyor belt passes continuously through the tin store, so that the spaces left by

removal of filled tins can be refurnished with further empty ones.

Manufacturing Procedure (Fancy Biscuits).—After baking, some varieties of biscuits are entirely enrobed with a coating of chocolate; others are coated on one surface with chocolate, sugar icing or “creamed.” These further processes are done on special machines.

For chocolate coating, the biscuits are passed on to a conveyor mesh belt, which carries them through the liquid chocolate mixture. For complete coating there is total immersion in the chocolate; if only one surface is to be coated, the mesh passes shallowly through the chocolate, so that the upper side of the biscuits remain uncovered. The coated biscuits pass into a cooling chamber, in which the covering hardens or sets, so that on emergence the biscuits can be packed.

For cream biscuits, the sweetened cream, with any desired colouring or flavouring, is filled into hoppers, and the machine automatically coats the biscuits with a gravity feed.

Dog Biscuits.—Less elaborate ovens are needed for dog biscuits, as it is not necessary to apply variable temperature controls. A steady temperature is applied, and it is not uncommon to find heating by coal or coke instead of gas.

The dough is a plain one, or may incorporate meat and flavourings. Rollers and cutters are adjusted to produce various thicknesses, sizes and shapes.

Packing Department.—As the biscuits, plain or fancy, emerge from the cooling chambers, the packing may be direct into biscuit tins by hand. When they are packeted, this may be done automatically by a machine attached to each of the oven lines, or the biscuits may be passed forward to a hand-packing department.

Packing presents many aspects, as the biscuits may be packed loose in layers in the usual square tins, or wrapped in half-pound, or other packets in air-tight paper packets. Again, assortments may be packed in 8-lb. tins, small 1-lb. tins or in fancy canisters. Packing represents a high proportion of total cost. Before filling, the tins may have to be cleaned in the Tin Washing Department.

Method of Costing.—This industry lends itself particularly to Batch Costing and Unit Output Costing. Standard costs can be established readily, and are useful for cost control.

There are no by-products, but there are minor process losses, such as broken, under- or over-baked, and otherwise damaged biscuits. The unit of cost is normally 1 cwt. of biscuits.

Procedure for Costing.—(a) *Materials.* The formula quantity for each batch provides a regular weight of baked biscuits, there

being only small variations arising from mis-shaped and over- or under-baked biscuits. The requisitions are normally referenced to each daily manufacturing order.

The value of raw materials required for a formula batch is obtained by pricing the quantities of the various ingredients. There is a small unavoidable loss in handling from store, weighing, etc., and in some organisations an average experienced loss is added to the batch cost. A return of the number of batches mixed is made to the office. A summary of the issue requisitions for each cost period gives the total ingredient cost.

The amount realised for broken and spoiled biscuits is credited, and varies considerably in different districts. Stores handling expenses may be added to cost of ingredients. So may be the cost of cleaning fruit, shelling eggs, etc., for convenience.

(b) *Labour*.—Wages can be readily ascertained for each type of biscuit by the use of Time Sheets. It is, however, satisfactory to assess this cost on the basis of oven hours, there being regular teams of workers on the production line. Tonnage cannot be used satisfactorily as a basis, as biscuits vary considerably in weight, a factor which is overcome by using the oven-hour method, since lighter biscuits occupy less oven time than heavier kinds. Better control is obtained if separate mixer-hour and oven-hour rates are used.

Special operations, such as coating, decorating, sandwich, etc., are performed apart from the actual baking operation, and the labour costs can be taken by Time Sheets.

(c) *Overhead Expenses*.—The apportionment of bakehouse overheads should be made to the respective operations or plant in accordance with the procedure outlined in Chapter XI of *Cost Accounting and Costing Methods*.

The items comprised include oven upkeep costs, works maintenance and supervision, heat, indirect labour, depreciation and sundry bakehouse expenses.

There is considerable variation in the capacity and cost of operation of different types of oven units. When there is more than one type or size of oven in use, it is necessary to establish an oven-hour rate for each. Alternatively, "oven units" may be calculated by taking the oven-hour of one type of oven as one unit, and assessing other ovens correspondingly. Thus, if an 80-ft. oven is 1 unit, another of 100-ft. may be 1.25 units per hour. In this method the bakehouse overheads would be calculated as unit-hour rates.

When machine-hour, oven-hour, or unit-hour rates are adopted, it is necessary for the Cost Office to be supplied with the actual times of usage for each production order.

It should be observed that many biscuit-makers use a rate-

per-cent. basis for recovery of overheads, and although this is simple to calculate and apply, it is liable to be exceedingly inaccurate when there are several types of ovens, and a variety of kinds of biscuits manufactured.

Reasonably reliable recovery of overheads can be ensured by the use of a machine-hour rate for dough mixing and separate oven-hour rates for each of the oven units.

Owing to the importance in cost of fuel, it is usual to show this as a separate item on the Cost Sheet. The charge varies according to the temperatures and time required for baking each type of biscuit.

Scrap and Defective Biscuits and Process Loss.—There is always a process loss in weight, due to the expulsion of moisture. The percentage varies, and whilst it may be as much as 16% (more usually about 13%) for hard biscuits, it may be half that for some varieties.

Broken and imperfect biscuits result in a loss more serious than the mere loss of ingredients, as wages, fuel and expenses on them are also lost, hence statistics should be maintained to indicate any excess loss from this cause. The usual loss is from about 1% to 5%, or more for fancy biscuits.

Some imperfect biscuits are sold, and should be credited against costs. Others may be reground and included in further dough mixings; they should be credited at net cost, and debited to the new production order at the same figure plus grinding cost.

Packing Costs.—Costs of packing materials—e.g., tins, paper liners, paper shavings, sealing bands, etc.—will be obtained by usual stores records.

Labour may be charged to each line packed from Time Sheets or Piece-work Tickets. Piece-work rates are often paid, and bonus rates may be arranged for good output assessed on a points basis.

Packing Department overheads are often charged as a rate per cwt., but this is unsatisfactory, owing to the many different packings for which weight is an inaccurate basis. A good method is to assess points values based on time study of labour and time involved. For example, if 1 cwt. of biscuits loose-packed in 8-lb. square tins is the unit, other packings can be given points values, thus :—

Per cwt. Biscuits.	Unit Value.
Loose in Square Tins, Plain	1.0
Do. do. Assorted	1.5
Wrapped Air-tight, 1 lb.	2.5
Do. do. Chocolate, 1 lb.	3.5

For each unit a value is calculated, by taking the total number of units in a period (actual or budget) and dividing into the total

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overheads. Each order packed may then be charged overheads for the number of units equivalent, as illustrated :—

Packing Overheads.
Four weeks of Period 8.

Total for Year, £1300.
Total Period 8, £100.

Class.	Weight Packed.	Unit Ratio.	Total Units.	Per Unit.	Total.			Per cwt. Packed.
	Cwts.			d.	£	s.	d.	d.
Plain, 8-lb. Tins	75	1.0	75	36.36	11	7	2	36.35
Assorted do.	80	1.5	120	36.36	18	3	6	54.52
Plain, 1-lb. Tins,								
Air-tight	60	2.5	150	36.36	22	14	8	99.00
Wrapped	90	3.5	315	36.36	47	14	8	129.29
Assorted do.								
					£100	0	0	

Administrative Overheads.—These may be charged at a rate per cwt., although some still prefer to apply as a percentage on total cost.

Despatch Expenses.—These include depot charges, care of tins, delivery to vans, etc., cartage, and cases when used, but they are often delivered uncased in the manufacturers' own vans. They are charged as a rate per cwt., or alternatively as a rate per tin, in which case the charge in the Cost Sheet is based on the number of tins per cwt.

Cost Sheets.—Separate Cost Sheets are prepared for each variety of biscuit. A specimen is given on page 139, which illustrates a convenient form of cost presentation. The batch is taken as the mix of a sack of flour (280 lbs.). The recipe and particulars of the ingredients are imaginary only for purposes of the example.

It will be noticed that the batch ingredient cost is first ascertained, followed by the baking cost.

Biscuits are packed in various ways—in packets contained in large tins, loose in tins, etc.—and the weight per tin varies considerably, according to the size, thickness and kind of biscuit. The example illustrates a pack holding 8 lbs., and reveals the factory cost per cwt. packed.

Cost Sheet.
Biscuits (Plain).

1. Batch cost.					s.	d.
Batch to specification :						
lb.						
280	Flour at 38s. 3d. per sack, less 4d. in the £	.	.	.	37	7.3500
20	Sugar at 48s. 6d. per cwt.	.	.	.	8	7.9285
20	Fat at 66s.	"	.	.	11	9.4285
1	Vol. at 37s.	"	.	.		3.9643
1½	Salt at 6s. 3d.	"	.	.		0.8370
322½						
37	Moisture loss (11.48%)	.	.	.	58	5.5083
285½						
5½	Breakage and spoils loss (1.84%), valued at 14s. cwt.	.	.	.		7.8750
280	Yield of usable biscuits per sack of flour used	.	.	.	57	9.6333
Equivalent to 23s. 1.45d. per cwt. of biscuits.						
Cost Period No. 12 (98 Mixings).					Total 245 cwts.	
2. Total and Unit cost per cwt.					Per cwt.	
Ingredients (per cwt. of usable biscuits as above)					£	s. d.
Bakehouse fuel					283	4 7
" wages					34	14 2
" Overhead Charges (based on oven-hours)					49	0 0
					32	13 4
Bakehouse Cost					£399	12 1
Packing Expenses (tins containing 8 lb. biscuits):						32 7.45
(Note.—A separate cost is prepared for other size containers.)						
14 tins at 1s. 1d. each					s. d.	
Wax paper liners					15	2
Shavings						5.98
Sealing bands						3.96
						3.21
Direct labour						16 3.15
Packing Dept. Overhead (unit or labour-hour rate used)						5 6
						2 2
Factory Cost per cwt.						56 6.6
Overheads.						
Administration at 6% on factory cost						3 4.72
Warehouse at 1.72d. per cwt.						1.72
Selling at 10% selling price, scale for type						7 0
Distribution, at scale for type						2 4
Total cost per cwt.						69 5.04

CHAPTER XXIV

OPHTHALMIC LENS AND SPECTACLE MANUFACTURING

IN this, and the following chapters the five main divisions of the ophthalmic lens and spectacle-making industry are considered. In order to describe the costing methods adequately, it is necessary to outline the general structure of the industry and the inter-relationship of each branch of it. It should be observed that although some manufacturers specialise in only one branch, others engage in several or all divisions of the industry, and the costing procedure appropriate to each function is necessary.

The Divisions of the Industry may be summarised as follows :—

1. *Mass Production of Lenses.* Manufacturers make ophthalmic lenses of the many optical powers in normal general demand, by mass-production methods. In addition, these manufacturers also make special ophthalmic lenses of powers which are not standard, and also precision lenses for special purposes, such as binoculars, periscopes, and scientific instruments. Some of the special-purpose lenses are of considerable size, and involve highly skilled work of very great precision.

2. *Spectacle-Frame Manufacture.* Large-scale production of many kinds of frames and parts occurs, especially in imitation tortoiseshell, fancy coloured materials, and steel. Production in real tortoiseshell, gold, silver, etc., also takes place. Frequently a repair department is maintained for the servicing needs of wholesale opticians (see below, para. 4).

3. *Spectacle-Case Manufacture,* mainly by mass-production methods.

4. *Wholesale Opticians.* These act as stockists and also perform a variety of manufacturing operations. Their functions may be summarised thus :—

- (a) Maintain stocks of lenses, frames and cases to supply retail opticians immediately with spectacles assembled in accordance with prescriptions, and any power of lens.
- (b) Build finished articles from components.
- (c) Cut lenses to required shapes of frame eye-pieces, grind the edges, and fit in frames at the correct angle.

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- (d) Grind lenses separately to deep or special powers. The "specials" made by grinding individually on spindles, instead of in quantities, are more expensive.
- (e) Undertake repairs, and act as advisers to retail opticians.

5. *Retail Opticians* supply by retail, and usually test and examine eyes to determine the correct lenses required.

The methods of production and the appropriate costing procedure for the separate divisions of the industry are described in Chapters XXV to XXVIII. It is considered undesirable to complicate the general descriptions by the addition of costing of special types of lenses, which would normally necessitate terminal or job costing procedure.

CHAPTER XXV

MASS MANUFACTURE OF OPHTHALMIC LENSES

THE types of lenses in sufficient general demand to make possible mass production fall into three main categories :

- (a) Bi-spheres.
- (b) Plano-cylinders.
- (c) Sphero-cylinders.

Lenses are normally 45 mm. or 47 mm. in diameter, and are produced in optical "powers", or degrees of optical correction, which form the basis of the oculist's instructions to the optician. The powers are the units of measurement common to all lenses and all surfaces and do not vary.

Bi-spheres are either concave or convex lenses having a spherical surface on both sides.

Plano-cylinders are lenses with one plane (or plano-) surface, but the other side is ground to a "cylindrical" power, which may be concave or convex.

Sphero-Cylinders are lenses with one surface of a spherical power, and the other a cylindrical power. The terms spherical and cylindrical need explanation.

A *spherical surface lens* may magnify or reduce, and provides an equal correcting action at any point on the spherical surface from a given focal point. The optical power varies from 0.00 dioptries to 20 dioptries (either concave or convex) by quarter dioptries.

A *cylindrical surface lens* has a slight concave or convex curvature like a portion of the side of a cylinder, and provides correcting action in one direction only (*i.e.*, alignment or astigmatism), and the powers vary for mass production by quarter dioptries from 0.00 to 8.00 dioptries. They exceed 8.00 dioptries where so required.

Both types of lens surface are produced by grinding flat blank circular pieces of white optical glass either by machinery or by hand. A modern development is the use of "plastic" instead of

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glass. It is ground and processed in the same manner as glass blanks.

Machine Grinding Method.—Lens blanks are affixed to a “block” having a surface like a giant mushroom. The blanks are secured by a pitch mounting medium. The grinding for convex lenses is done by a concave grinding block of the same curvature, which fits that of the block holding the blanks, and which in a rotating motion grinds the exposed face of the blanks. The rotating is obtained by a system of power-driven spindles, a series of blocks being operated simultaneously. Conversely for concave lenses.

The number of blanks that can be ground on a given block depends, for physical reasons, on the power (or degree of curvature) and thickness of the blanks. It will be apparent that the deeper the lens power the smaller is the number which can be produced on a single block.

Blocks for spherical lenses have a spherical surface which may be so slightly spherical as to appear almost flat (for low-power lenses, say 0.25–2.0), and each block may hold approximately forty-five pairs of lenses at a time. As the lens power required increases, the spherical surface of the blocks becomes more pronounced, and fewer blanks can be mounted on it, for instance, only five to ten pairs are generally possible on the higher range of powers.

A similar grinding process is used for cylindrical lenses, except that, besides the rotating movement, the grinding block also has a reciprocating movement. For cylindrical surfaces also the depth of power depends on thickness, and the greater the depth, the less the number of lenses which can be produced on each block.

Rough Cylinder Lenses (i.e., blanks with a cylindrical power ground on one surface, leaving the other surface blank for subsequent spherical grinding as required) are mass produced both for re-sale and for stock which may be used for subsequent issue when required for the manufacture of spherocylinders.

The Labour of mounting the blanks on the pitch-covered grinding blocks is done by “blockers”. The “grinders” who tend the grinding operations use a gently abrasive powder. Polishing and finishing are done by felt rotary pads operated on spindles. This completed, a “taker-off” removes the lenses from the blocks, and passes them to a “cleaner”, who removes adhering pitch by immersing the lenses in naphtha solvent, and finally washes them in water. A staff of experienced girls inspects and classifies the lenses, which are carefully packeted and passed to the finished stores.

Hand (or Individual Spindle) Grinding Method.—Spherical lenses (bi-spheres) of about 6–10 dioptries or higher powers are

sometimes ground by hand one at a time. Or they may be ground individually on separate spindles.

Plano-cylinders are ground mechanically for the lower powers, but higher powers are sometimes done by hand to obtain the desired trueness.

Sphero-cylinders up to say 1 dioptré on the sphere are mechanically ground, but over that may be ground by hand, or individually on separate spindles. For grinding, the lens is fixed on to a knob-like holder by pitch.

Method of Costing.—Process costing is appropriate, and can be suitably arranged to ascertain costs by types and power groups. Alternatively, the method of Unit Operation Costing described in Chapter XVIII of *Cost Accounting and Costing Methods* can be applied to the mass-production operations.

Owing to the fact that the number of combinations of variations in lenses, even of those mass produced, runs into many hundreds, costing and pricing of power groups are adopted. There is so little variation in costs within certain ranges of powers that the adoption of groups for convenience of costing and price-fixing is found to be satisfactory. Such price grouping is customary in this trade.

Procedure for Costing.—The power groupings which may be used are exemplified below. It is not necessary for present purposes to state all the groups, and an example of each type of lens is given, viz.:

(A) *Bi-Spherical First-Quality Lenses (Concave or Convex).*

POWER GROUPS (SPHERICAL).

(Note that in each group the power varies normally by quarter dioptrés although listed in wider groupings.)

Dioptrés.		Dioptrés.		Dioptrés.		Dioptrés.
0.00	to	2.00		8.25	to	10.00
2.25	„	4.00		10.25	„	14.50
4.25	„	6.00		15.00	„	18.00
6.25	„	8.00		18.50	„	20.00

(B) *Plano-Cylinders First-Quality Lenses (Concave or Convex).*

POWER GROUPS (CYLINDRICAL).

Dioptrés.		Dioptrés.
0.25	to	2.00
2.25	„	4.00
4.25	„	6.00

(C) *Sphero-Cylinders First Quality.*

POWER GROUPS.

Spherical Surface (one side).		Cylindrical Surface (other side).	
Dioptries.	Dioptries.	Dioptries.	Dioptries.
0.25	to 2.00	0.25 to 2.00 combined with any of the spherical surfaces.	
2.25	„ 4.00		
4.25	„ 6.00		
and so on to			
16.50	to 18.00		
0.25	to 2.00	2.25 to 4.00 (ditto)	
2.25	„ 4.00		
4.25	„ 6.00		
and so on to			
16.50	to 18.00		
0.25	to 2.00	4.25 to 6.00 (ditto)	
2.25	„ 4.00		
4.25	„ 6.00		
6.25	„ 8.00		
8.25	„ 10.00		

Many other variations arise, including size of lens—i.e., whether 45 mm. or 47 mm., and alternative combinations of concave and convex surfaces, etc.

The procedure and consideration of the elements of cost will now be described.

Raw Materials.—*Blank glass discs* of the two sizes 45-mm. and 47-mm. diameter are purchased by weight from glass manufacturers. They were chiefly imported, but since the war, production has been developed in this country. The thickness of the blanks varies from 2.25 mm. upwards to satisfy power requirements. Those of 5 mm. and over in thickness may be more expensive.

Normal methods of stock control are used. Issues to production are priced, and summarised on abstracts in order that the appropriate Group Process Account may be debited. It facilitates analysis if each Group Process Account is given a Code or Syllabus Order Number. As the blanks are bought “per lb.”, the number of blanks per lb. for each thickness and size is determined for the purpose of charging out.

Operational Materials, such as abrasive paste, rouge, spirits of naphtha, are relatively small in cost, and are conveniently included in the factory overhead expenses.

Labour.—The details of labour direct wages are obtained by way of the usual methods, and the analysis on the Wages Abstract provides for the cost attributable to each of the following functions :

(i) *Machine Grinding Department*: (a) Blocking; (b) Grinding; (c) Polishing; (d) Taking Off; (e) Cleaning.

(ii) *Hand Grinding Department*: (a) Knobbing; (b) Hand Grinding; (c) Blocking and Smoothing on machine; (d) Polishing (machine); (e) Taking Off; (f) Cleaning.

(iii) *Inspection and Warehouse Classification of Lenses*: Further analysis of this labour cost is not undertaken.

Ascertaining the Direct Labour Charge to Group Cost Accounts. In each department of production the groups or teams of operators have their appropriate functions. The foreman records output, etc., on special forms which provide for the following labour calculations being made:

In the Machine Grinding Department:

Blocking Cost. The weekly number of blocks of each size (i.e., according to the number of lenses each holds) operated. This permits computation of the total number of lenses blocked in the costing period (say 4 weeks or a quarter). Using the wages total ((i) (a) above) it is possible to determine the blocking labour cost per lens surface by simple division. This is correct, as blocking cost is practically the same for each surface irrespective of power group.

Grinding Cost. By dividing the number of blocks ground during the cost period into the total grinding labour ((i) b above) the cost per block is obtained. The labour cost per block is practically constant, but the cost per lens surface is dependent on the number of surfaces ground on a block, hence the charge to lens power groups for surfacing can be determined from the total number of lenses on all the blocks of each size (i.e., holding the same number of surfaces).

Polishing. The same method is used as for grinding.

Taking Off. The same method is used as for blocking.

Cleaning. There is no cleaning for the first side of the lens, as the cleaning is not done until the other side has been ground and polished. The cleaning cost is the same regardless of group, hence the cost per lens is found by dividing the total number cleaned into the total cleaners' wages for the cost period.

In the Hand Grinding Department:

Knobbing. The unit cost per lens is the knobbing wages ((ii) (a) above) divided by the total lenses "knobbed".

Hand Grinding. This can be determined by time sheets, as for job costing, but it is better to calculate a labour-hour rate and the output per labour hour for each power group. The deeper (or higher) the power, the lower the hourly output and the greater the cost per lens.

The resulting departmental or functional totals are resolved into recovery rates, which may be :

(a) A percentage on direct wages for each department or "centre".

(b) A Unit Rate in each department according to incidence—namely, a rate per lens, per block, per labour-hour, or per surface ground, as the case may be.

The methods of calculation are exemplified in *Cost Accounting and Costing Methods*, Chapter XII.

If the factory is not large, and the incidence of overheads is relatively small, it may be sufficient to compute an overall percentage on direct labour or a rate per labour-hour for the production departments as a whole.

Administration Overhead.—It is usual to recover as a percentage on factory cost, and this is reasonably reliable, as greater costs for glass and labour on the more expensive lenses involve a greater incidence of number of items of administration. On the other hand, most of the administration is unrelated to the factory cost, and the alternate method of recovery could be a unit rate per lens.

Illustrations of Cost Accounts and other records are given on pages 150–154 as representative of the special features of the industry.

The Process Cost Sheet has been curtailed for simplicity, and in practice further columns would be provided for higher power groups.

The illustrations are :

(a) Stores Ledger Account for Flat Blanks and issues to production (page 150).

(b) Labour Analysis and Production Summary, giving appropriate Labour Cost for each category (page 151).

(c) Cost Summary Account for bi-sphere lenses for power groups up to seven dioptries. Similar accounts would be prepared for power groups for each other type of lens—*e.g.*, Rough Cylinders, Plano-Cylinders, and Sphero-Cylinders (pages 152–153).

(d) Production Summary showing reworkings made and extent of breakages during manufacture (page 154).

Stores Ledger Account for Flat Blanks.

Blank Thickness : 2½ mm.
Pairs Lenses per lb. : 21.
Diameter : 45 mm.

Supplier : Blanks & Co., Ltd.
Maximum Stock :
Minimum Stock :
Pairs Lenses. Lbs
12,012 579
4,900 200

Receipts.										Issues.										Balance.		Remarks.
Date.	Invoice or G.R. Note Ref.	Quantity.		Rate per lb.	£ s. d.			Date.	Req. No.	Lens Process Account.	Quantity.		Rate per lb.	£ s. d.			Lbs.	Pairs.				
		Lbs.	Pairs (by con- ver- sion).		Pairs.	Lbs. (by con- ver- sion).	£				s.	d.										
19... Oct. 11	A 265	200	4200	2s. 6d. less 5%	28	15	0	19... Oct. 31	14,875	Blapheres 1-25-2-0 Plano cyla. 1-25-2-0 Rough cyla. 0-25-2-0 do. 3-25-4-0 do. 4-25-6-0	4,300 330 2,000 2,100 1,200	205 16 95 100 57					500	10,500	Stock 80,943 £59 7s. 6d.			
Nov. 2	A 432	258	5313		30	0	10	Nov. 30	10,672	Blapheres 1-25-2-0 Plano cyla. 1-25-2-0 Rough cyla. 0-25-2-0 do. 2-25-4-0 do. 4-25-6-0	1,600 500 4,200 1,400 900	76 24 200 67 43	2s. 6d. less 5%	56	3	4	997	4,770				
" 29	A 567	200	4200		28	15	0															
Dec. 10	A 622	300	6300	"	35	12	0	Dec. 31	22,436	Blapheres 1-25-2-0 Plano cyla. 1-25-2-0 Rough cyla. 0-25-2-0 do. 2-25-4-0 do. 4-25-6-0	8,600 3,200 500 4,200 800 1,600	410 152 24 200 38 76	"	48	13	9	970	5,698				
" 26	A 731	200	4200	"	28	15	0															
								Dec. 31		Difference in Stock Account	10,800 108	490 5	"	58	3	9	980	5,888	Balance			
													"	11	10		375	5,775	Physical Stock 81,1343 £59 13s. 2d.			
														5168	12	8						

Note.—Issues may be credited to the account either in monthly totals (as above) as summarized in a subsidiary Lens Journal, or credited as and when issued each day.

Wages Analysis and Production Summary, Quarter Ended
Dec. 31, 19.....

Department.	Gross Wages and National Insurance (Company's contribution).			Production and Labour Cost per Unit (for Charging to Process Accounts).		
				Unit.	Quantity (including Reworks).	Labour Cost per Unit.
						Pence.
	£	s.	d.			
<i>Machine Grinding Depts.</i>						
Blocking	1127	6	10	Lens surface	1,028,753	0.263
Grinding (Spheres)	297	17	1	Block	10,160	7.036
do. (Cylinders)	170	12	5	Block	4,800	8.531
Polishing (Spheres)	306	6	11	Block	10,040	7.323
do. (Cylinders)	280	9	0	Block	4,730	14.230
Taking off	272	13	10	Lens surface	1,055,581	0.062
Cleaning	198	6	10	Pair lenses	204,300	0.233
<i>Hand and Individual Spindle Grinding Depts.</i>						
Knobbing	672	3	4	Lens	504,125	0.320
Hand grinding (Spheres)	1523	13	0	Labour hours	18,600	19.660
Blocking and smoothing	294	10	6	Block	12,600	5.610
Polishing	309	17	4	Block	12,560	5.921
Taking off	296	0	10	Lens surface	490,000	0.145
Cleaning	158	15	10	Pair lenses	185,000	0.206
<i>Inspection, Grading and Warehouse and Despatch</i>	1191	2	6	Pair lenses	390,000	0.733
	£7099	16	3			

Flat Lens Process Cost Summaries

Bispherical Lenses (Concave and Convex)

Power Groups :		0-00-2-00 Dioptres.		(45 m.m.)	
Production for Quarter (First and Second Quality).		4860 dozen Pairs.		2-24	
Item of Cost.	Cost per Unit.	Quantity Units (including Reworks).	Total Cost.	Cost per Doz. Pairs.	Quantity Units (including Reworks).
Flat Blanks—per Stores Ledger :			£ s. d.	d.	
mm. Pairs.					
2½ 55,052 . . .	2s. 6d. less 5% per lb.	2,502 lb.	} 348	10 8	17-21
2½ 9,100 . . .	do.	433 lb.			
2½ 24,300 . . .	do.				
3 31,200 . . .	do.				
3½ 26,448 . . .	do.				
4 24,200 . . .	do.				
4½ 13,288 . . .	do.				
4½ 8,930 . . .	do.				
5 7,006 . . .	4s. 6d. per lb. net				
199,524					
Inwards Carriage on Blanks	0-5d. per lb.		6	2 3	0-30
Total Material . . .			354	12 11	17-51
Labour—per Wages Summary :					
Machine Grinding Depts.					
Blocking . . .	0-263 per surface	235,608 surfaces	258	3 8	300,792 surfaces
Grinding (Spheres) . . .	7-036 per block	2,740 blocks	80	6 7	4,662 blocks
Polishing (Spheres) . . .	7-323 per block	2,730 blocks	83	6 0	4,650 blocks
Taking off . . .	0-062 per surface	235,824 surfaces	60	18 5	299,624 surfaces
Cleaning . . .	0-233 per pair lens	58,320 pairs	56	12 4	74,508 pairs
Hand and Individual Spindle Grinding Depts.					
Knobbing . . .	0-320 per lens				
Hand grinding (Spheres) . . .	19-660 per labour hr.				
Blocking and Smoothing . . .	5-610 per block				
Polishing . . .	5-921 per block				
Taking off . . .	0-145 per lens surface				
Cleaning . . .	0-206 per pair lenses				
Inspection, Grading, Warehouse and Despatch . . .	0-733 per pair lenses	59,450 pr. lenses	181	11 5	75,622 pr. lens
Total Labour . . .			720	18 5	35-60
Prime Cost . . .			1075	11 4	53-11
Factory Overhead Expenses.		Factory Overhead.			Factory Overhead.
Blocking, Knobbing, Taking off and Cleaning . . .	32% on Depl. Labour	£ s. d. 120 4 7			£ s. d. 153 7 10
Grinding and Polishing . . .	60% on Depl. Labour	98 3 6			167 2 8
Hand grinding . . .	5-50d. per hour				
Inspection . . .	0-5d. per pair lenses	123 17 1			157 10 11
			342	5 2	16-90
Factory Cost . . .			1417	16 6	70-01
Administration : 8% on Factory Cost . . .			113	8 6	5-60
Total Cost (excl. Selling Adverts and Carriage)			1531	5 0	75-61
Selling expenses . . .	Per abstract		3	10 11	0-18
Advertising . . .	2% on total cost		30	12 6	1-51
Carriage (average all areas).	2d. per doz. pairs		40	10 0	2-00
Delivered Cost . . .			1605	18 5	79-30
Production transferred to Finished Stock (at selling price per dozen pairs) . . .		Dozen At Pairs. s. d.			Dozen At Pairs. s. d.
First-quality lenses . . .		3636 6 9	1227 3 0		4677 7 6
Second-quality lenses . . .		1224 6 0	367 4 0		1532 6 9
		4860	1594	7 0	6209
		Per cent. on Cost.			Per cent. on Cost.
Profit on Production for Quarter . . .		0-70%	11	11 5	2-24
Loss do. do. . .					

Some explanatory notes concerning the

for Quarter Ended December 31, 19.....
for Powers 0.25 to 7.0 Dioptres.

Diameter.)

4.00 Dioptres.				4.25-6.00 Dioptres.				6.50-7.00 Dioptres.													
dozen Pairs.				2844 dozen Pairs.				1208 dozen Pairs.													
Total Cost.			Cost per doz. Pairs.	Quantity Units (including Reworks).	Total Cost.			Cost per doz. Pairs.	Quantity Units (including Reworks).	Total Cost.			Cost per doz. Pairs.								
£	s.	d.	d.		£	s.	d.	d.		£	s.	d.	d.								
579	2	11	22-39	1,861 lb. 1,107 lb.	} 352	9	0	29-74	812 lb. 701 lb.	96 157	8 14	6 6	} 50-49								
10	3	2	0-39											6	3	8	0-52	3	3	0	0-63
589	6	1	22-78											358	12	8	30-26	257	6	0	51-12
329	12	4		88,743 surfaces	97	4	11		—	—	—	—									
136	13	6		2,546 blocks	74	12	10		—	—	—										
141	17	8		2,536 blocks	77	7	7		—	—	—										
77	8	1		88,263 surfaces	22	16	0		—	—	—										
72	6	8		21,780 pairs	21	2	11		—	—	—										
230	19	3	38-22	54,552 lens	72	14	9		66,006 lens	88	0	2									
988	17	6		1,800 hours	147	9	0		2,200 hours	180	4	4									
1578	3	7		1,562 blocks	36	10	3		2,160 blocks	50	9	10									
				1,558 blocks	38	8	9		2,170 blocks	53	10	9									
				54,206 lens s'f'ce	32	15	0		59,072 surfaces	35	13	9									
			61-00	12,348 pairs	10	12	0		14,496 pairs	12	8	10									
				33,206 pr. lens	101	8	4		14,820 pairs	45	5	3									
478	1	5		18-48	733	2	4		61-87	465	12	11		92-51							
2056	5	0		79-48	1091	15	0		92-13	722	18	11		143-63							
164	10	0		6-36	Factory Overhead.					Factory Overhead.											
				£ s. d.				£ s. d.													
				82 6 7				43 11 3													
				136 3 8				62 8 4													
				41 5 0				50 8 4													
				114 11 1				30 17 6													
2220	15	0	85-84		374	6	4	31-59		187	5	5	37-21								
5	17	10	0-23		1466	1	4	123-72		910	4	4	180-84								
44	8	4	1-72		117	5	8	9-90		72	16	4	14-47								
51	14	10	2-00		1583	7	0	133-62		983	0	8	195-31								
			89-79		3	11	9	0-30		2	11	6	0-51								
					31	13	4	2-67		19	13	2	3-90								
					23	14	0	2-00		10	1	4	2-00								
					1642	6	1	138-59		1015	6	8	201-72								
1753	17	6	87-78	Doz. At				Doz. At													
517	1	0		Pairs. s. d.				Pairs. s. d.													
				1928 15 0	1446	0	0	968 18 0	871	4	0										
				916 10 6	480	18	0	240 15 0	180	0	0										
2270	18	6		2844	£1926	18	0	162-61	1208	£1051	4	0	208-85								
				Per cent. on Cost.				Per cent. on Cost.													
				17-33%																	
51	17	6	2-01		284	11	11	24-02		35	17	4	7-13								

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EXPLANATORY NOTES CONCERNING COST SUMMARY ON
PAGES 152-153.

(a) When preparing Quarterly Cost Summaries appropriate adjustment would need to be made for work in progress at each stage of production by suitable Process Control Accounts.

(b) The Cost Summary on pages 152 and 153 for bispherical lenses illustrates in simple form the special features of manufacture of this type of lens. The Cost Summary for "rough cylinders" will be framed in much the same way, showing the appropriate Material Cost and the Processing, Labour and Overhead Costs for grinding the power on the cylindrical side only. When costing the sphero-cylinders the Cost Summary will comprise the total cost of the appropriate rough cylinders and the Labour and Overhead Cost of grinding. For the appropriate spherical powers on the reverse side, the method of allocation of labour to the Cost Summaries is the same as for the bispherical lenses.

(c) Wastages in process are accounted for in the unit costing by dividing the total cost of each group by the net yield of first- and second-quality lenses.

Production Summary: Quarter Ended:

1. Bispherical : Power groups 0.25 to 7.00 Dioptries.					
	Total.	0.25-2.00 Dioptries.	2.25-4.00 Dioptries.	4.25-6.00 Dioptries.	6.50 to 7.00 Dioptries.
Blanks issued	199,524	64,152	81,948	37,488	15,936
Lens reworked (add)	8,644	3,100	2,143	2,078	1,323
Lens to be reworked (less)	208,168	67,252	84,091	39,566	17,259
Breakages (less)	9,286	3,722	2,562	1,516	1,486
Yield, first and second quality	198,882	63,530	81,529	38,050	15,773
	17,430 (8.8%)	5,210 (8.2%)	7,021 (8.6%)	3,922 (10.3%)	1,277 (8.1%)
	181,452	58,320	74,508	34,128	14,496
2. Etc. Summary continues with figures for other types and groups.					

CHAPTER XXVI

SPECTACLE-FRAMES MANUFACTURE

THERE are many varieties and types of spectacle frames into which the manufactured lenses are fitted by wholesale opticians and retailing opticians.

The manufacture of frames and frame parts may be considered under various main divisions, but a reasonable grouping is as follows :—

(a) Nickel silver and steel frames of many shapes and designs, made from nickel silver and steel wire of various gauges or thickness.

(b) Gold or gold-plated frames manufactured on similar lines to those in (a), but requiring greater precision, and an additional process of gold plating.

(c) Imitation and real tortoiseshell frames, with which may be included coloured frames in fancy patterns made from cellulose acetate.

(d) Subsidiary departments for fittings and sundry operations in connection with the above-named productions; included is a General Repair Department which handles all types of repairs sent for attention by wholesale opticians.

The Manufacturing Functions include :—

- (i) *Press Shop and Tool Room* : Stamping out joints, hinges, butts; forming, setting and flattening bridges; cutting, drawing and tapering pear tips; piercing collets; lettering with size, etc., etc.
- (ii) *Soldering Shop* : Making and soldering joints; soldering joints to main frame; soldering cable to butt, etc.
- (iii) *Making Screws* : Machine shop for manufacture of screws of all required sizes.
- (iv) *Frame Department* : Cutting and bending eyewires; making butts and cable and cutting to length; making assembling sides and fitting pear tips.
- (v) *Nickelling and Golding Shop* : As may be required.
- (vi) *Polishing Department* : As may be required.
- (vii) *Assembling Department*.

Tortoiseshell frames will be manufactured in :—

- (viii) *Shell Frame Department.* Cutting shell (real or imitation) to size and slotting and grinding, and working by heat treatment to shape; polishing; fitting hinges, reinforcing and assembly.

In addition, it will normally be necessary to maintain a central production control department, material and finished stock warehouse and despatch department.

The operations are specialised, and highly skilled labour is employed. For metal frames processes are almost exclusively mechanised, but for tortoiseshell and "plastic" frames mechanisation occurs to a lesser extent, as the material is easily worked by manual processes.

Method of Costing.—Job or Batch Costing is usually employed. If the volume of production of a few particular types is sufficiently great as to warrant semi-intensive mass production, a system of standard costing can be incorporated with advantage.

Procedure for Costing.—*Materials.* Usual stores procedure may be adopted, using Stores Received and Issued vouchers or notes, and records being maintained on the perpetual or continuous inventory method. Issues will be summarised on Abstracts of Materials, thus providing the debits to the Batch or Job Accounts concerned. These will be prepared weekly or monthly as a rule.

If Batch Costing is adopted, the cost on an average basis is obtained by dividing the total value of issues for the period by the number of frames produced.

If Standard Costing is employed, issues will be charged at pre-arranged standard unit values, and at the end of each period the actual issue costs will be introduced, so that the adjustment of variations may be made in the Control Accounts. More detailed descriptions of how these standard costs may be operated are given in *Cost Accounting and Costing Methods*, Chapters XXIV and XXV.

In general, the cost of the material used for each type of frame thus follows normal simple procedure. Special care is necessary, however, in respect of gold and real tortoiseshell, owing to the high value of these materials.

Labour. Having regard to the numerous individual operations, the cost of labour needs careful attention. Job cards or work tickets may be used.

There are some operations which are repetitive, and they are fundamentally the same, irrespective of the type of frame being produced. Thus, there may be several shapes obtained by

special dies, and these may be grouped for costing purposes, as a common labour cost emerges.

Factory Overheads, including indirect labour, should be apportioned to production departments by the most appropriate methods. Indirect labour may be recovered as a percentage on the Direct Production Labour Cost in each department, so that each department will have a separate rate. The factory overhead of each department will normally need to be expressed as a Departmental Labour Percentage, except when a more appropriate basis can be determined—*i.e.*, per 1000 screws produced, or per dozen frames polished, or per foot of frame cable produced, etc.

There are a number of cost units arising in some departments which lend themselves to specific bases of recovery of overheads with particular incidence to such units, but whether these may be adopted will depend on the degree of analysis to production centres adopted by the cost accountant. The considerations are fully discussed in Chapters XI and XII of *Cost Accounting and Costing Methods*.

Administration General Overhead Expenses.—As the cost of labour and factory overhead will be substantially the same for each type of frame having the same manufacturing operations, irrespective of the cost of the materials used—*i.e.*, both for gold and nickel silver—it would be incorrect to base administrative overhead as a percentage on Factory Cost for production of this nature. It is suggested that as much of the overheads as possible should be charged as General Factory Overhead, leaving only unapportionable administration to be recovered separately. Such administration so remaining for recovery should be grouped as to :

(a) Those items of expense attracted to the manufacturing costs of the article (exclusive of materials).

(b) Those items of expense which vary by reason of the full costs of the manufactured article.

The total of (a) should be recovered as a percentage on the combined total of Labour and Factory Overhead; and item (b) as a percentage on Factory Cost.

A Cost Summary of a standard nickel-silver spectacle frame is illustrated, which draws attention to the main points involved in costing in this industry (see pages 158 and 159).

Metal Spectacle Frames.
Cost Summary.

Type frame : Nickel Standard B2.
Production : 12,000 frames.

Period : 4 weeks ended 2.3.44.
Job No. : 362/B2/44.

Frame Parts.	Material Used (Code).	Issued from Store.				Scrap Sold.				Total Cost.			Per Dozen Frames.		
		Weight.		Per lb.	Total.	Weight.	Per lb.	Total.	£	s.	d.				
		lbs.	ozs.									lbs.		ozs.	£
Eyewires	Nickel wire, PZ1	94	4	2	44	11	3	10	1	1	10	11	3	10	2-036
Bridges	do. L3	54	9	2	5	6	11	10	1	1	8	6	1	8	1-400
Joints	Nickel sheet, O3	69	9	1	9	6	1	9	1	5	6	4	16	3	1-155
Pins	Nickel wire, O4	5	10	2	3	6	12	8					12	8	0-182
Screws	do. AO2	5	10	2	34		12	11					12	11	0-155
Butts	do. O4	97	14	2	3	11	0	3	1	13	8	9	6	7	2-225
Cables	do. L3	125	7	3	11	24	11	3	1	8	1	24	3	1	5-797
Pear tips	Ferry sheet, CA	4	0	4	6		18	0	1	3	7		14	5	0-175
		456	15			61	12	6		4	1				
	Less scrap	94	0												
	Net usage	362	15									57	11	6	1-817

15 — 5-907 ozs. per doz. frames.

CHAPTER XXVII

SPECTACLE-CASE MANUFACTURE

SPECTACLE cases are manufactured by mass-production and semi-mass production methods from tinplate sheets covered externally with rexine or similar material, and having a velveteen lining. The type of case normally used is manufactured in several standard sizes of similar construction with snap lid, the appearance of which is familiar to the reader. The degree of mass-production methods utilised varies with each manufacturer, but the method of costing outlined in this chapter could be readily applied to any factory producing this type of standard product.

Method of Production.—The tinplate sheets are purchased in standard sizes; the sheets are guillotined into appropriate lengths, out of which are stamped the bodies and the lids of the cases. Each operator on the production line undertakes one operation, and the body and lid stampings are pressed into the appropriate shape by successive operators. The outer coverings and linings are cut from the appropriate materials, both of which have been treated with an adhesive substance. After the lids and body of each case have been assembled by means of joint pins, to which is attached a spring and collar, the outer covering and lining are applied under pressure.

The cases are packed, after examination, into cardboard boxes holding one dozen each, the cardboard boxes being packed into larger cartons, which contain a gross or more spectacle cases, for dispatch to the wholesaler.

Method of Costing.—The method selected will depend on the methods of production, as follows:—

Unit Output Costing. This is suitable when a few types of standard cases are produced. A reference number to the type enables the costs for a weekly or other period to be segregated, and the unit cost obtained by using the quantity of output as divisor.

Batch Costing of types may be arranged.

Job Costing. A works order issued for a definite number of a type forms the basis of recording costs. From this the cost per gross is easily obtained.

Costing Procedure follows usual lines and calls for but little special comment.

In general, the only differences between types of cases are

shape and quality of material. It follows, therefore, that after appropriate analysis of works overheads over the respective production shops, the recovery can be effected as a rate per gross, or as a percentage on labour wages, owing to the degree of uniformity of labour grades employed.

There are size variations, which can be provided for in the costing by the adoption of carefully calculated ratios for use in applying a cost differential.

Cost Sheets.—A specimen Cost Sheet is illustrated on page 162, showing the cost of a batch of a gross cases of a standard snap-lid type. Cases of leather and other fancy materials are also produced of envelope styles, but the same principles of costing briefly outlined above will apply. In the latter event it will probably be necessary first to apportion labour and overhead to "production centres" or departments manufacturing the various types of cases, before recovery rates can be determined.

CHAPTER XXVIII

WHOLESALE OPTICIANS

THE functions of wholesale opticians comprise more than those usually undertaken by wholesalers in most trades, and consequently it is necessary to introduce some form of departmental costing. The purely wholesaling activities are concerned with the supply of frames, frame parts, spectacle cases and uncut lenses. Other departments commonly operated deal respectively with prescriptions, surfacing or grinding lenses, cutting stock lenses to special sizes and shapes, grinding of the edges of lenses and fitting into spectacle frames, fusing and repairing. In addition, regard has to be paid to general service departments, which include Building Services, Plant and Power Services, Engineers and Maintenance and Despatch.

Method of Costing.—Departmental Costing is appropriate combined with Job and Unit Output Costing for some of the departments.

Costing Procedure.—A very convenient basis for costing is to prepare a Departmental Manufacturing and Trading Account, say quarterly. In this account the prime costs and overheads should be analysed in columnar form, or separate analysis schedules may be prepared under the following departmental headings :—

Wholesaling :

- (a) Frames and Frame Parts.
- (b) Spectacle Cases.
- (c) Uncut Lenses.

Manufacturing :

- (d) Prescription Department (known usually as RX Department).
- (e) Surfacing Department.
- (f) Glazing and Edging Department.
- (g) Fusing Department.
- (h) Repair Department.

Services :

- (j) Buildings.
- (k) Plant and Power.
- (l) Engineers and Maintenance.
- (m) Despatch.

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The allocation of materials and labour should present but little difficulty, and so far as overhead expenses are concerned the procedure described in *Cost Accounting and Costing Methods*, Chapters IX to XI, is suitable. Specific procedure, with illustrative forms, appears on pages 136 to 138 of the book named.

When the departmental analysis has been completed, the totals for the Service Departments should be re-apportioned, on an appropriate basis, to each of the manufacturing departments, having regard to the benefit each received from the respective Services.

Application of Costs to the Departments.

Wholesaling Frames. The frames are purchased from frame manufacturers. To the purchase price of each type of frame factored there will be added the ascertained percentage to recover the warehousing and handling costs, consisting of wages and apportioned expenses. The latter figure is obtained from the Departmental Analysis Account.

This percentage should be included in the costs for all frames handled, whether sold direct to retail opticians, or supplied to the wholesaler's own Prescription Department for lenses to be fitted.

Wholesaling Spectacle Cases. The warehousing and handling costs of this department may be recovered as either: (a) a percentage on the purchase cost of the cases, or (b) a unit cost "per dozen cases". The method (b) is more reliable, as it eliminates the influence of price fluctuations.

Wholesaling Uncut Lenses. The departmental overheads divided by the number of dozen pairs of lenses handled provides a basis for recovery of overheads as a rate per dozen pairs of lenses.

Prescription Department. This department is responsible for: (i) Handling all incoming prescriptions from retail opticians, (ii) controlling the stocks of mass-produced lenses, (iii) selecting the prescribed lens and issuing to the Glazing Department for fitting into the frame, (iv) verifying that the lenses are correctly set in the frame in accordance with the prescription (e.g., that the axis of the lens is correctly set), (v) checking the finished job, packing and despatch. It is usual for this department to invoice and post or deliver the prescribed spectacles with as much speed as possible to the retail optician. This department is the pivot of the wholesaler's business, and usually co-ordinates the functions of the other departments. Thus, if a prescribed lens is not in stock, it is obtained from lens producers, or one may be adapted in the Surfacing Department, or may be made from "rough cylinder" stock.

Various methods are available for charging to cost the department's expenses, but the most convenient and reasonably accurate one is a unit cost per prescription, calculated on the basis of statistical estimates of numbers handled. In this connection the use of a continuous "Z" Chart is useful. This shows the progressive movement of numbers week by week during the year, and the progressive annual moving average. The construction, and an illustration of the "Z" chart are given in *Business Statistics and Statistical Method*.*

Surfacing Department. This section of the business is responsible for surfacing, by grinding, flat blanks or rough cylinders into special lenses not normally stocked. Each such lens is affixed to the grinding spindle by a pitch base. The grinding or surfacing operations are done by grinders who control a battery of spindles, but normally only one lens is ground per spindle. The deeper the power of the lens, or the more intricate the specification, the greater is the cost. It is therefore necessary to establish points units based on time tests for each type of special lens. From these records a rate per points unit can be calculated, and applied to each group surfaced.

Using this method, both labour and overheads can be recovered in the rate. The cost of flat blanks or rough cylinders so ground is charged at Stores Ledger prices and allowance made for average breakages.

Glazing and Edging Department. The operations undertaken include :—

(i) Cutting the appropriate stock or special lens (which is usually 45 mm. or 47 mm. in diameter) to the shape required to fit the frame.

(ii) Grinding the edges of the lens (called "edging").

(iii) Fitting in the frame correctly at the prescribed angle.

Here again a system of "unit" or "ratio" costing should be established on the lines already described.

Fusing and Repair Department. Simple job costs may be used, applying the departmental overheads as a percentage on labour.

Administration and Selling Expenses.—It is desirable that as many of the administration expenses as possible should be incorporated in the departmental analyses, but insofar as expenses remain not so allocated, the administration expenses may be recovered as a percentage on total factory cost.

Cost Summaries.—Two illustrations are given on pages 168 and 169. The first shows the costs of a standard prescription

* By the same author and publisher, 8 John St., W.C. 1. 7s. 6d.

Costing of First-Quality Bi-spherical Stock Lens Edged and Glazed to Metal or Shell Frames Supplied by Customer.

Quarterly Costing.

Period : 4th Quarter, 19.....

Type Lens :	Plano-2 Dioptres.		2.25-4.0 Dioptres.	
	Per Dozen Pairs.		Per Dozen Pairs.	
	d.	d.	d.	d.
(i) Lens :				
Ex stock at mass lens cost		81.000		90.000
Addition for waste, breakages, etc. (12½%)		10.125		11.250
		91.125		101.250
(ii) Prescription Department : Labour and Overhead per Departmental Summary, 6½d. per pair		78.000		78.000
(iii) Glazing and Edging Department :				
Labour :				
Cutting at 1.75d. per unit, 2 units	3.500		5.250	
" 1.75d. " 3 " 				
Edging at 10.0d. " 3 " 	30.000		50.000	
" 10.0d. " 5 " 				
	33.500		55.250	
Departmental Overhead, 140% on labour	46.900		77.350	
		80.400		132.600
Factory Cost		249.525		311.850
(iv) Administration : 5% on Factory Cost		12.476		15.592
		262.001		327.442
(v) Selling and Distribution : 2% on Factory Cost		5.240		6.549
		267.241		333.991
Total cost per dozen pairs		22.270		27.833
Total cost per pair		24.000		29.000
Selling price per pair		1.730		1.167
Profit margin per pair		7.8%		4.2%
Profit, per cent. on cost				

Note.—Costs of only two types of lenses are given above, but additional columns or separate summaries can be introduced for other types or groups.

Costing of Pair Sphero-Cylinder Lenses (Range, say, Sphere 10.25–14 Dioptres, Cylinder 2.25–4 Dioptres) Specially Ground, and Edged and Glazed to Frames Supplied by Wholesaler.

Job Costing.

Job No. : 146/3/43.

	Per Pair.		Cost per Pair.	
	s.	d.	s.	d.
(i) <i>Lens Cost :</i>				
<i>Rough Cylinders</i> (2.25–4 Dioptres) ex stock	1	3.000		
<i>Surfacing Department :</i>				
Labour (2 surfaces) : 28 units at 0.56d. per unit	1	3.680		
	2	6.680		
Addition for breakages, etc, 12½%		3.835		
	2	10.515		
Overhead : Departmental Rate, 125% on labour	1	7.600	4	6.115
(ii) <i>Prescription Department :</i>				
Labour and Overhead per Departmental Summary, 6½d. per pair		6.500		
Addition for special surfacing		3.000		
				9.500
(iii) <i>Glazing and Edging Department :</i>				
Labour :				
Cutting at 1.75d. per unit, 6 units		10.500		
Edging at 10.0d. „ 10 „		100.000		
		110.500		
Departmental Overhead, 140% on labour		154.700		
		265.200	1	10.100
Lens and Mounting, Factory Cost			7	1.715
(iv) <i>Frame :</i>				
Per pair (Type H 4263) at cost	8	6		
Frame Department handling, 26% thereon	2	2.520	10	8.250
(v) <i>Case :</i>				
Per dozen at cost	6	0.000		
Case Department handling per Departmental Account, 1s. 4½d. per dozen	1	4.500		
	7	4.500		7.375
Factory cost of job			18	5.610
(vi) <i>Administration : 5% on Factory Cost</i>				11.080
(vii) <i>Selling and Distribution : 2% on Factory Cost</i>			19	4.690
				4.654
Total cost of job			19	9.344
(viii) <i>Profit : 9.9% on total cost</i>			1	11.656
(ix) <i>Selling Price</i>			21	9.000

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job, where a stock lens is used, the frame is sent in by the retail optician to be fitted with low-power lenses. The second is a particular job cost suitable where the wholesaler has to surface lenses specially and fit into a frame supplied by him.

It should be observed that in a business of this nature the costing should be modified to meet any special requirements.

CHAPTER XXIX

MAKING OF MEDICINAL TABLETS

THERE are enormous quantities of tablets produced for medicinal and similar purposes, and this large output is made possible by the use of power-driven mixing, milling and tablet-making machines. The ingredients have to be well "granulated" into fine powder, sifted and mixed, so that all parts of the bulk contain the same proportion of the materials specified in the prescription. All the particles must therefore be thoroughly disintegrated before tableting commences. The tablets are formed by compression of the mixture, with or without the admixture of a binding substance, such as wheat starch, milk sugar, silica, arrowroot, etc., according to the nature of the main ingredients.

Manufacturing Procedure.—The ingredients are weighed out according to the specification, recipe or prescription. Thorough mixing takes place in a mixer, for example fitted with rotary arms and baffles. The mixed powder is usually passed through a rotating sifting machine, and greater refinement of the powder is obtained by grinding in an "end runner mill" or, say, a Redrop Periflo mill. The powder is then ready for the tableting machine, unless it is of a type which requires thorough drying to ensure easy running in the feed to the machine. Gas or electric ovens are used, or a specialised one like the Mitchell Oven, in which air current and temperature are controlled. The powder is spread on trays for this drying.

Tableting Machines are made in various designs, from a "Single Punch" to the well-known "Manesty" multiple punch rotary machine. According to the sizes of tablets specified, so are different capacity machines used, the most common being one with a circular plate in which are fitted the holes or dies into which the prepared powder falls ready for the punches which descend to compress it into tablet form. The general utility machine, which will produce tablets of $\frac{3}{16}$ in. to $\frac{7}{8}$ in. diameter, is a single circuit machine fitted with 16 punches and dies and produces an average of 330 tablets per minute. More specialised machines designed for more limited production ranges may have double circuits with a total of 32 or more punches and dies, and up to 1200/1500 tablets per minutes are produced. The commercial tableting range varies from about $\frac{1}{8}$ in. diam to $2\frac{1}{2}$ in. diam. The powder is served through a channel from a hopper.

There is a small amount of the powder which unavoidably escapes being tableted, and this is collected, together with broken tablets, for re-working with subsequent mixings. There is also a small process loss of powder which is not recoverable, as it is lost in the air, or on the floor.

The formed tablets run from the machine into a collecting container. They are issued as required to the packing department, where they are filled into small bottles, boxes or bulk containers as may be specified in the packing production orders. There are various filling methods in use, again adjusted according to the nature and size of the tablets being packed. Some tablet machines are fitted with automatic counters which propel the requisite number directly into the container. Another method, used with fairly large tablets, is determination by weight, and yet again there are on the market machines based on gravity feeding, the varying numbers required being governed by a graduated sliding lever bar. In general practice, however, when filling small tablets, the correct number (say fifty) is ensured by agitating a small scoopful of tablets in a perforated plate in a shallow box, so that each of the fifty perforations holds one tablet.

Method of Costing.—Unit or Single Output Costing is particularly suitable. The unit of cost is normally "per 1000 tablets"; but for bulk supplies it may be "per kilogram" of tablets. Batch Costing is also widely used. Because of the extensive range of medicinal tablets now being produced, often incorporating ingredients of very high cost, batching is of great importance from the Costing viewpoint. Strict laboratory control is maintained during mixings, and any analysis sample rejected is tied up with its particular batch, and the whole of that batch rejected. Thus, the Costings Department, having the necessary details of batch mixings, is able to produce accurate costings, together with statistical details of immense value in similar ranges of production.

Procedure for Costing. (a) *Materials.*—The control of materials involves the special care mentioned on page 42, and it is usual for issues to be made in batch quantities of suitable size, so that the theoretical weight and actual production weight by batches can be recorded and checked. The weight of tablets made and delivered to bulk storage is recorded by the tableting foreman, and a copy is sent to the Cost Office, and one to the Store. The bulk issues to the Packing Department are the subject of usual stores issue requisitions and control. In order that the losses in weight up to the tableting stage, and the losses in number of tablets during packing may be carefully supervised, with a view to these being minimised, a statistical summary should be prepared for each stock line. This should include figures in respect of

every production order, and, if production is in long runs, the figures should be reported and recorded daily. The following is a suitable form :

Schedule of Production and Process Losses.

Tablets, Stock Card No. 291.

Cost Period No. :

Cost Period 3.	T.O. No.	Nominal No.	Actual Tab-letted.	Loss.	% on Nom.	P.O. No.	Issued Packers.	No. Packed.	Loss.	%.	No. Re-worked.	% of Loss.
19.....		000's										
Feb. 1	432	100	99,576	424	0.424	301	99,576	98,500	1,076	1.081	980	91
2	432	200	198,000	760	0.380	316	50,000	49,475	525	1.050	499	95
8	441	100	99,624	376	0.376	321	120,000	119,100	900	0.750	846	94
13	445	100	99,642	358	0.358	333	100,000	99,200	800	0.800	768	96
		500	496,842	1,918	0.383		369,576	366,275	3,301	0.893	3,093	93.7
Cost Period 4.												
Feb. 15												

(Schedule continues as above)

Alternatively to having a schedule for each line of product made, the schedules can be prepared for each size of tablet of similar category, and for each type of pack.

(b) *Labour.* The operatives complete Time Sheets, showing time spent on each batch or production order, which are abstracted in the Cost Office. When there is a continuous production of a single product, this may be unnecessary, as analysis of the wages will give the cost. Owing to the care required for medicinal products, it is usual to have each batch numbered and an indication of the operatives responsible. The time records of operatives and machines are necessary when shop overheads are recovered by hourly rates.

(c) *Overhead Expenses.* It is necessary, for accurate costing, that machine and shop overheads be carefully apportioned, so that machine-hour and labour-hour rates can be determined. The use of a Register of Plant and Machines facilitates the ascertainment of the annual charge for depreciation. There are examples of suitable rulings for such a register on page 126 of *Cost Accounting and Costing Methods*, and on pages 150 to 152 the principles and methods of computing the rates are given. It is better to exclude any charge for interest on the capital values of the machines. General shop overheads may be separately recovered as a labour-hour rate.

An example of the application of machine rates to a particular production order is as follows :—

In costing period No. 7 the analysis of machine usage times on Production Order No. 274 were found to be as stated in the first column of the table on page 174. The ascertained machine-hour

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rates are entered in the second column ; and the charge to P.O. 274 is extended into the third column.

Tablet Production Order No. 274.

Schedule of Charges per Machines Used.

Machine or Plant.	Time used.	Rate per hr.	Charge.		
			£	s.	d.
Mixers	600	2.25	5	12	6
Sifter, Automatic	25	0.76		1	7
R.P. Mill	150	2.50	1	11	3
End Runner Mill	950	2.50	9	17	11
Gas Oven	1,740	1.85	13	8	3
Electric Oven	3,280	1.75	23	18	4
Mitchell Oven	100	8.30	3	9	2
Tableting Machine (Rotary)	8,020	3.45	115	5	9
			£173	4	9

It is not desirable that the wages of direct labour tending the machines should be included in the machine-hour rates, as workers at different rates of pay may operate them from time to time.

Process Losses.—A reconciliation is effected between issues of materials for theoretical outturn per batch and the actual weight of (a) good tablets passed to store, plus (b) weight of broken, dirty or contaminated tablets. The difference between theoretical and actual weight so ascertained is the loss by the slight spillage in the hopper or flow into the compressing moulds. Some of this dust is recovered and reworked, but some is completely lost. Comparative records of damaged tablets, and of spillage loss are maintained for control purposes. This is particularly important when the ingredients are of high value, or of a type necessitating meticulous safety control.

In the later stage of filling into bottles, etc., a similar reconciliation of quantities, and losses has to be effected.

Cost Sheets.—It is customary to prepare separate Cost Sheets for each kind of tablet, and for each production order. For continuous production of one line a single Cost Sheet for the full cost period will suffice.

The example on page 175 refers to tablets made and filled into bottles, corked, waxed and labelled. Another illustration appears on page 47, headed Process No. X.

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Production Order No. : 3972.

Cost Period : No. 4

Sod. Co. Tablets, in bottles of 100.
Corked, waxed and capped.

Production : million Tablets.

				Total.			Per 100.
				£	s.	d.	pence
1. PROCESS COSTS.							
<i>Ingredients.</i>							
Chemical A.	As Materials Abstracts	.	.				
"	B.	"	"				
"	C.	"	"				
"	D.	"	"				
Starch	"	"	"				
Flavouring	"	"	"				
Colouring	"	"	"				
Total ingredients cost (process loss% included)				1,450	10	0	2-901
<i>Labour.</i>							
Mixing, etc.	.	.	.	425	10	0	
Drying	.	.	.	5	17	6	
Tableting	.	.	.	167	5	0	
Total direct labour cost				598	12	6	1-197
<i>Factory Overhead Expenses (Processes).</i>							
Mixing 225 man-hrs. at 2-25d. per hr.	.	.	.	2	2	2	
Drying 720 man-hrs. at 8-30d. per hr.	.	.	.	24	18	0	
Milling 236 man-hrs. at 2-50d. per hr.	.	.	.	2	9	2	
Tableting 4470 man-hrs. at 3-45d. per hr.	.	.	.	64	5	2	
General 7300 labour-hrs. at 1-60d. per hr.	.	.	.	45	12	6	
Total process overheads				139	7	0	0-279
Total factory cost of tablets				2,188	9	6	4-377
1. PACKING COSTS.							
<i>Materials, as Materials Abstracts.</i>							
Bottles, including 0-6% wastage	.	.	.	6502	2	8	
Corks, " 0-53% "	.	.	.	405	4	4	
Labels	.	.	.	12	6	0	
Wool	.	.	.	73	8	0	
Wax	.	.	.	16	19	0	
Screw caps	.	.	.	830	0	0	
Total packing materials				7,840	0	0	15-680
<i>Labour, as per Labour Abstract.</i>							
Labelling	.	.	.	342	0	0	
Filling	.	.	.	988	10	6	
Corking	.	.	.	330	1	6	
Wax dipping	.	.	.	295	0	6	
Capping	.	.	.	215	9	0	
Overheads, 20% on direct labour				2,171	1	6	4-342
Total cost of tablets bottled				434	4	0	0-868
3. DESPATCH (cartons, cases, banding, stencilling and handling)				12,633	15	0	25-267
4. ADMINISTRATIVE OVERHEAD EXPENSES, 10% on cost of filled tablets				996	16	0	1-994
				1,263	7	4	2-527
Total cost				£14,893	18	4	29-788

CHAPTER XXX

MANUFACTURE OF SUGAR CONFECTIONERY (SWEETS)

THE confectionery which is the subject of consideration in this chapter consists of boiled sweets, caramels, pastilles and other sweetmeats. In the case of chocolates there are additional operations, and although much of the manufacturing and costing procedure about to be described may be applicable, it has been found convenient to devote a separate chapter to chocolate-making.

Manufacturing Procedure.—The basic methods and recipes in the making of sugar confectionery are applicable to both small and large manufacturers, but with increase in output, departmentalisation assumes more importance, and costing involves more analysis. As considerable variations of detail must necessarily arise, the manufacturing and costing procedure given is treated in a general manner.

Recipes. A Recipe Book is kept, and contains details of the lines produced. In particular there is a full description of the product and the ingredients required. There is a specification for each ingredient, the weight necessary for each batch and the size of batch which will be worked to produce a stated weight of finished product. The recipe describes the method to be followed, and the appropriate boiling or cooking times and temperatures.

In some instances statistics of losses in preparation, mixing and processing are recorded in the recipe book, based on experiments, and these assist in the general control by affording a comparison with the actual losses revealed by costing.

Materials. The receiving and storage of raw materials follow normal control procedure in the use of Goods Received Notes, Issue Requisition Notes, Stores Bin Cards and Stores Ledger Accounts. Issues of batch quantities of ingredients appropriate to the recipe about to be put into production may be the subject of a collective requisition by the manager of the department concerned, or in larger firms by the Planning Department.

The chief ingredients are various grades of cane sugar (white, light-brown, and dark brown), glucose syrup, treacle and golden syrup, citric or tartaric acid, chocolate powder, butter, cocoa butter, gelatine, biscuits, a variety of nuts, honey, raisins, icing sugar, condensed milk, and a considerable number of flavourings and colouring materials. Fresh milk and cream may also be used for some recipes.

Packing materials assume important proportions and include waxed paper, cellophane, greaseproof paper, used for wrapping the sweets; various assortments of paper "cups", tinfoils, decorative wrappings and labels; cardboard boxes, ribbons, tape and boxing materials; jars, tins, canisters, bottle neckbands, labels; cartons, and wooden boxes.

Stores Control. It is necessary to maintain the usual Bin Card, or Stock Card Records of receipts and issues for the main store raw materials. There should be a physical check at least monthly, so that the records provide a reliable perpetual inventory.

In a large factory with a considerable number of producing departments it is sometimes the practice to issue materials from the main store to a department against the requisitions in bulk by the foreman, who is responsible for accounting for these stocks and his production. When this is the case, the foreman should keep a departmental Record Card of each type of material he receives, as shown on page 178.

This form shows the balance held at the beginning of each four-weekly period, the quantities received, and requisition numbers. At the end of each period each card is totalled. The physical balance is checked and entered, and deducted, so that the balance is the usage for the period. Allowance has to be made for materials in progress. In one well-known manufacturer's method of control the closing quantities of departmental stock on hand are shown on a Monthly Stock Sheet prepared by the foreman, and on the reverse side of this sheet the quantity of each material in course of production, or finished and not yet passed to the next process or Finished Stock Store, are recorded. This sheet is illustrated on page 180.

These quantities are then transferred to a Stock Adjustment Sheet, there being a separate one for each department. An example for Boiled Sweets Department is given on page 182, as is also one for the Liquorice Department.

The stocks so arrived at are priced at the costs when issued, and thus stock values held in each department are available for the monthly departmental manufacturing accounts.

Transfers of Materials, whether finished, part-finished or raw, from one department to another are accompanied by a Materials Transfer Note, a duplicate being passed to the Cost Office for adjustment of the Departmental Stock and Process Cost Accounts. The part-finished stock transferred to another department for further process or operations is valued at the accumulated cost of the previous department from which it has been received, and consequently the stock carried in that state is treated as "raw materials" in that department, and at the end of each costing

Monthly Stock Sheet (Obverse).

Dept No. : WEDNESDAY, Week ended :

The following is a complete list of Raw Materials, Essences, Colour, etc., only (for use in manufacture) in my room at 6 p.m. to-day.

Signature of Foreman
or Forewoman :

No manufactured Goods
to be put on this side.

Description of Goods.	Cwt.	Qrs.	Lbs.	Oz.	Qts.	Pts.
Glucose . . .						
Common Crys. . .						
Best Sugar . . .						
Castor . . . do. . .						
Raw . . . do. . .						
Pieces . . . do. . .						
Starch, New . . .						
Starch, Confectioners . .						
Slab Oil . . .						
Flour . . .						
Gelatine . . .						
Gum Arabic . . .						
..... . .						
..... . .						
Scrap (if any) . . .						

ESSENCES, COLOURS, ETC.

--	--	--	--	--	--	--

Posted in Ledger by Date.....

(GOODS MADE in Room) or Stove, see over.

N.B.—Add in writing any Raw Material in stock that is not printed above, and return to this Office by 10 o'clock Wednesday.

MANUFACTURE OF SUGAR CONFECTIONERY 181

Monthly Stock Sheet (*Reverse*).

State here the quantity and description of all manufactured
Goods in your Room or Store.

Quantity.	Goods.

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Stock Adjustment (Raw Materials).

Dept. : Boiled Sweets.

Four weeks ended : 28th Jan., 19.....

Raw Material.	Opening Stock, 1/1/19...	Quantities Received.	Total.	Less Closing Stock, 28.1.19...	Used.
{ Sugar . A					
{ " finished and partly finished stock converted to raw material . B					
{ Glucose, Syrups, etc. . A					
{ " " . do. . B					
{ Flavours . . . do. . A					
{ " . . . do. . B					
{ Colours . . . do. . A					
{ " . . . do. . B					
{ All other raw material (specified) . A					
{ " " " " do. . B					

Note.—The lines marked A are quantities unprocessed but lying in the department and those marked B are materials in process or finished and still held in the department.

Stock Adjustment (Raw Materials).

Dept. : Liquorice Sweets.

Four weeks ended : 28th Jan., 19.....

Raw Material.	Opening Stock, 1/1/19...	Quantities Received.	Total.	Less Closing Stock, 28.1.19...	Quantity Used.
{ Sugar					
{ " finished and partly finished stock converted to raw material . .					
{ Sugar Invert. . . do. .					
{ Glucose " . . . do. .					
{ Syrup . . . do. .					
{ Molasses . . . do. .					
{ Black Jack . . . do. .					
{ " " . . . do. .					
{ Flour . . . do. .					
{ Flavours . . . do. .					
{ Colour . . . do. .					
{ Other raw materials (specified) . .					
{ " " " " do. .					
{ Scrap " " " " . .					

period any material still in process is similarly converted to the quantities in the form in which first received in the department.

It has been found in practice that this gives very reliable stock figures.

The Producing Departments will each be under the supervision of a foreman or manager. An important part of this official's functions is close control of materials usage and the minimising of process losses. It is not possible in the space available to describe all the methods of production, nor the actual operations for the many kinds of sweetmeats, but the following are representative :

Boiled Sweets Department. The main ingredients, sugar, glucose syrup and tartaric or citric acid, according to recipe, are mixed and boiled. Alternatively, a high proportion of cane-sugar is used, so that during the boiling process part of it is changed to "invert sugar" by the addition of "cream of tartar", and accordingly a reduced quantity of the already "inverted" glucose syrup is needed. The following methods are used :

(a) The boiling may be in simple open pans over an open fire, usually gas. It is claimed that this simple method results in a better flavour and a clear and transparent sweet. There are also boilings in vacuum vessels ; and a speedy method of passing the ingredients over coiled heated tubes in a special boiler.

The boiled liquid is usually run or drained off into large trays, and at this stage flavourings and colouring matter, and any other admixtures, are introduced. Whilst still liquid, the mixture is emptied on to a large cooling-slab, and worked into a semi-solid mass. In this state the mass is gradually pressed or rolled into a shape and width suitable for passing into the receiving opening of a shaping machine. In this machine there is an automatic device for stamping the sweets to shape from which the sweets emerge, but not quite separated from one another. The strip of sweets passes through a separating device, and the "dropped" sweets are collected for transference to a wrapping machine, of which there are several kinds. Sometimes they are wrapped by hand, or packed unwrapped.

(b) In another "Dropping" method the boiled mass is passed through a pair of rollers, which have a moulding action on account of shaped depressions or moulds on their surfaces. The shaped sweets are "dropped" by being passed through a revolving separating machine. The rollers may be operated by hand or by power. The "dropped" sweets are then passed through a wrapping machine.

(c) In the Hansella Process each sweet is formed individually. The boiled mass passes between two vertical revolving wheels, in each of which there are opposing sets of half moulds attached to springs. As the strip of the prepared mass passes between the

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wheels, the two half moulds spring together and shape individual sweets. The sweets are collected and fed into a machine, which wraps them in small pieces of paper in a twist or folded manner. The finished sweets are then passed to the packing section.

Several wrapping machines operate with vertically operating wrapping mechanism, but one type is a horizontal circular revolving plate in which are holes the size of the sweets. The operator spreads a number of sweets over the surface so that a sweet rests in each hole, and as the plate moves round each sweet is automatically twist-wrapped in small pieces of paper.

(d) A particularly simple method of shaping after boiling is used for rectangular "mints". The liquid mass is poured into shallow trays, just deep enough for the desired thickness of the sweet. A rectangular frame of nearly the same size as the tray, and fitted with a small rectangular mesh, is pressed on to the cooled mass. This cuts the sweetmeat into the size and shape known as oblong "plastics" or pieces, after which these are separated and fed to the automatic wrapping machine.

(e) If any of these sweets are used as "centres", i.e., covered with, say, chocolate, etc., the covering is done in another department and the wrapping is usually eliminated.

It will be seen from the above described methods that the manufacturing operations resolve themselves into boiling; "dropping"; coating or covering if used as "centres"; wrapping and finally packing in bottles, boxes, etc.

Caramels Department. After boiling of the ingredients, the mass is run or rolled into the desired thickness and size suitable for cutting into familiar shapes by hand or mechanically. The plain caramels may be packed on layer papers unwrapped; or they may be passed through a machine which wraps the caramels individually. The caramels are packed in stock size boxes, or in bottles, canisters, etc., as may be adopted. Some kinds are coated with icing sugar or chocolate.

Pastilles and Gums Department involve mixing of ingredients, boiling, moulding, stoving and usually crystallising in the case of pastilles. Owing to moisture allowed to be absorbed there is a process gain in weight of 10% or even more.

Chocolates Department. If the chocolate powder is manufactured from the raw cocoa beans, the processes of cleaning the beans, roasting and nibbing (to remove the husks or shells) are involved. The product at this stage is cocoa nibs. Sometimes several kinds will be blended.

The cocoa nibs after blending, grinding and sifting are mixed in a melangeur with sugar, cocoa butter (obtained from grinding cocoa nibs, and then pressing the viscous "mass" from which the excess fat emerges as cocoa butter), and any desired flavouring.

The mixture is passed through steel rollers, thus producing a thick paste, after which further cocoa butter is added. The mixture is then further refined by rolling or beating in a vessel known as a *conche*, which gives this process the name of "conching".

The chocolate may then be moulded for sale as block chocolate in a great variety of shapes. In this form it may be plain, or may incorporate milk, nuts, raisins or other tasty ingredients. The moulding is a lengthy operation requiring a machine for feeding the warm soft chocolate to the moulds passing under it. The filled moulds pass on a conveyor to the wrapping and packing department, cooling on the way.

The chocolate may also be used for enrobing, *i.e.*, covering or coating centres. Common centres which come to mind include creams, biscuits, caramels, nuts and nut mixtures, marzipans, toffee and sometimes sugar encased liqueurs. It will be apparent that "centre" making involves a variety of manufacturing operations.

Smaller manufacturers will generally commence their chocolate-making from the stage of buying in chocolate already prepared.

Assortment Confectionery. When the manufacturing of "self lines" or individual varieties of sweetmeats has been completed, it is sometimes the practice to box a number of each of selected varieties as an assortment ready for sale by the retailers. This is particularly so for chocolates, caramels, gums and pastilles.

Method of Costing.—The popular method of costing in this industry is Batch Costing, using the cwt. as the unit. Some makers take the opportunity of introducing current costs of important ingredients so that the final figure is a cost of greater utility to the management for price fixing. In the author's opinion this is a most unsatisfactory departure from the principles of costing and vitiates the possibility of reconciliation between the Cost Accounts and the Financial Accounts; nor are the costs true. Batch Costing with the use of actual component costs is convenient and satisfactory.

The industry lends itself well to Process Costing or departmentally to Unit or Single Output Costings, and in both cases the unit of cost can be maintained as a cwt. or as 100 lbs., the former being the one used most.

Procedure for Costing.—*Materials.* These are issued from Stores against Stores Requisition Notes issued by the production department concerned (*e.g.*, Boiled Sweets, Caramels, etc.). These requisitions are based on the Production Orders issued to the departments, and may take the form of a demand for each ingredient as per standard recipe for so many batches. It simplifies records if each department and each product is assigned a code

reference number. The Production Order and Stores Requisition Notes subsequently go to the Cost Department to provide data for debiting the Cost Account of the product concerned.

Materials other than ingredients, *e.g.*, boxing or enrobing, will be issued against Stores Requisitions in the usual manner.

The procedure is the same whether daily, weekly or quantity production orders are used, as in any case the Requisition Notes will be sent daily, for pricing and abstracting, to the Cost Department.

The details of stores routine, and pricing of materials are fully described in *Cost Accounting and Costing Methods*, Chapter V, and on page 159, a method of preparation of these costs for debiting to the Process or Batch Cost Account. In the eighth edition of that book, on page 31, are given the considerations which have to be taken into account when determining the maximum and minimum stock to be carried for each kind of material.

In the case of bulk production, in which the processed materials proceed from the first department to another for further processing (*e.g.*, raw cocoa beans issued to the Cleaning Department, pass to Roasting and Nibbing Process, then to the Grinding Department and so on) a materials production sheet or card may accompany the material to the next department concerned, a carbon copy being sent to the Cost Department. This enables the cost accountant to record the process loss, and to arrive at the cost of the emerging product at each stage.

Wages Costs. Piece rates are usually paid, although time rates with an output bonus appropriate are not uncommon. Work tickets provide the cost accountant with such details as production order number, output of units produced, hours on each. The procedure is the same if production is done by teams.

When there is indirect labour the cost may be apportioned in each department proportionately to direct labour on each production order; or it may be included in the factory overhead expenses for the respective departments.

In the Cost Office the details are abstracted in a form convenient for posting to the Cost Account concerned.

Factory Overheads. These are analysed to secure departmental totals. These totals are then used as a basis for determining recovery rates expressed as a cost per cwt.; a rate per labour-hour; or as a percentage on direct wages. In departments where production is highly mechanised, a rate per machine-hour or plant-hour is more suitable.

The many points to be considered in making the departmental analysis are fully explained in Chapter XI of *Cost Accounting and Costing Methods*, and in Chapter XII the considerations as to choice of recovery rates and their calculation are dealt with in detail.

Administration overheads are applied as a percentage on cost or as a rate per cwt. The method of applying a percentage on selling price, which is sometimes used, is not satisfactory. It virtually becomes a rate of "what the price will bear", and in any case selling price is not a measure of administration incidence.

Selling and distribution expenses may be recovered satisfactorily by a dual charge; (a) a rate per cwt. to cover all selling costs which are common to all lines, i.e., the central administration expenses, (b) a rate as a unit or percentage charge for any special selling costs such as advertising the line, samples and travellers' commission.

For control purposes analysis of selling and distribution costs may be by classes; areas or districts; salesmen and agents; and recovery by apportionment resolved into a unit (say, per cwt.) charge to each line of product, or a percentage on value.

Consideration has to be given to such factors as units, weights or values of turnover; number of transactions, distance and nature of distribution; and the relationship of sales turnover to the potential market. It follows that, whatever analysis of sales turnover is adopted, the same basis must be applied to analysis of costs of selling and distribution.

Cost Sheets.—A separate Cost Sheet is prepared for each line, and summarises the costs of the batches or quantities produced in each cost period (weekly, fortnightly or monthly); or, if more suitable, for each bulk production order or sequence of batches.

It is useful for ready comparison to prepare a columnar summary of the costs per cwt. for each kind of article produced, covering a period of six or twelve months. An example is given on page 189.

A specimen Cost Sheet for caramel-making costs is shown on page 188, and one for chocolate on page 61.

When the product consists of an assortment (e.g., chocolates with various centres; caramels made from different recipes and flavourings; pastilles or gums of assorted shapes and flavours), the costs of the individual items are first ascertained, and such costs form the basis of the ingredients charged for the assortment. The costing is completed by the inclusion of the wages for packing into boxes or jars, etc., and the addition of administration, selling and distribution overheads. The completed Cost Sheet will be in similar form to that given on page 188.

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Cost Summary.

Unwrapped Caramels, Recipe No. 3.

Packed in boxes of lbs., in outers of 112 lbs.

No. of batches made Total output Cost period No.

Materials.		Average Price.	Total Cost.			Per Cwt.		Prev. Period.	
Weight.	Ingredients.								
Cwts. lbs. oz.	Sugar Glucose Condensed Milk Butter Cocoa Butter Cornflour Flavouring		£	s.	d.	s.	d.	s.	d.
	Total Process Loss in Cooking, etc.								
	Yield								
Labour.		£	s.	d.					
Mixing									
Boiling									
Cutting									
Departmental Overheads									
Department cost									
Packing Department.		£	s.	d.					
Layer paper									
Boxing material									
Boxes									
Wages									
Departmental Overheads									
Factory cost									
Administration % on factory cost									
Selling per cwt.									
Distribution per cwt.									
Total cost									

CHAPTER XXXI

CANNING OF PEAS AND BEANS

THE canning of peas and beans on a large scale involves various preparatory operations which differ from those that apply to the canning of fresh fruits and vegetables. In the latter commodities the process of preparation in each case follows substantially the same course—viz., topping, tailing, cleaning, and stoning, as detailed in Chapter V, but for peas and beans the processes of preparation before canning are carried out in specialised plant, mainly by mechanical methods involving very little hand labour.

A. Canned Peas.—Peas may be canned either “*Fresh*” (i.e., immediately on removal from the pod, which must, of course, be done without delay after gathering) or “*Processed*” (i.e., by soaking dried peas which have been stored for a considerable time in bulk).

FRESH PEAS are canned in a short season in July, August and early September, when the crops of early or maincrop varieties are ready. The peas may be either “*Pulled Peas*” which are bought by the canners from farmers in 40-lb. bags (i.e., the pods have been removed from the vine in the fields by agricultural labour employed by the farmer); or they may be purchased on the vine by the cwt., and the peas are mechanically removed from the pods by a machine called a “*viner*”. This throws out the vine and empty pods at one end, and ejects the shelled peas at the other. When the peas have been so removed from the pods they are passed immediately into the cannery plant for washing, sorting and removal of waste, after which the peas are carried, by means of small bucket elevators, to be either partially processed or directly filled into cans by mechanical fillers. In small canneries some of these operations are done by hand labour, but in the larger ones a high degree of mechanisation is essential for the rapid flow of a great volume of peas through the processes.

PROCESSED OR DRIED PEAS. These are peas purchased in sacks by pickers from the farmers, who have already threshed and dried their crops. “*Pickers*” is the trade description of the intermediaries who buy the dried peas and sort and grade them according to quality and size. Some large canners have their own “*picking*” or grading department.

The percentage of waste is determined by sample test at the date of purchase, and this determines the price paid, which is scaled so that the greater the percentage of waste the lower is the price.

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The picker purchases either for (a) picking and grading for the purpose of canning, or packeting, or (b) picking and grading for sale in bulk as dried peas to wholesalers or retailers in the grocery trade.

The picker's operations are done by hand or mechanically as follows :

(i) When picked by hand labour, the peas are run on to a table or moving belt, and the operatives sort into grades, and pick off any defective peas.

(ii) When graded by machines, there are two general methods : (a) The peas are fed into a rotating drum which sorts out the defective and misshapen peas by a system of needles or spikes ; (b) the peas are run on to a shaking screen and belt so devised as to sort out automatically the various qualities. In each case all dust and waste matter are separated, and the pickings (i.e., rejected peas) are collected and sold as waste for cattle fodder, etc.

Costing Procedure.—(1) *Fresh Peas.* The cost of the peas delivered into the cannery is compiled in a summary under four headings, (a) to (e) mentioned below. The use of code numbers facilitates this analysis. The costs consist of : (a) the invoiced prices of the fresh peas purchased ; (b) carriage inwards ; (c) carriage outwards on waste and swads ; (d) wages of viner operators ; (e) appropriate overheads. From the total of these sums is deducted the amount received from the sale of swads and other waste. Separate summaries may be made for "Pulled Peas" and "Vined Peas". An average price per lb. or per cwt. is determined for the weight of each type passed into the cannery. Wages abstracts provide the analysis of labour costs.

(2) *Processed or Dried Peas.* The cost of each batch purchased is ascertained. This Batch Cost is built up from the reports made as each batch passes through the Picking Department. To facilitate this a code number is allocated to each batch or a purchase order number may be used.

A specimen cost summary is illustrated on page 193.

The overhead expenses of the Packing Department are obtained from the departmental analysis of total expenses in accordance with normal practice. Usually these are recovered in costs as a rate per cwt. based on an expense and production budget of tonnage to be picked. The budget of expenses and tonnage may be revised monthly as the season progresses.

The total cost of each batch picked is thus obtained, together with the cost per cwt., and this forms the charge to the Cost Account for "Canned Processed Peas" as each batch is passed into the soaking tanks for canning.

Dried Peas Cost Summary.

Season : 194.../4...

Batch No. : 64.

Sample loss : 20.9%.

Quantity purchased

Cwt. Owt.

113

Date recd. into factory : 28.10.4...

Less Pickings

22

Dustage

2

Date picked : From Dec. 6th to Dec. 15th, 194...

24 = 21.2%

Yield picked peas

89

Invoice No.	Invoice Date.	Goods Received, Ref. No.	Cost per cwt.	Weight.			Total Cost of Batch.			Sample Picking Loss.	Remarks.
				Cwts.	qr.	lbs.	£	s.	d.		
A 266	24.10.4...	Z 316	s. d. 44 0	59	0	0	129	16	0	% 18	
B 267	25.10.4...	Z 318	41 0	48	0	0	98	8	0	24	
C 184	23.10.4...	Z 325	47 0	6	0	0	14	2	0	15	
				113	0	0	242	6	0		
				1 0	Commission		5	13	0		
					Sack hire			7	0		
					Storage		1	3	0		
					Haulage		3	0	9		
				2 6	Dressing charge		14	2	6		
					Picking, labour		15	0	0		
				8 6	Picking Dept. Over-head (on yield)		37	16	6		
							319	8	9		
				Less Sale of pickings :							
					£ s. d.						
				15 cwts. at 16s.	12 0 0						
				7 cwts. at 25s.	8 15 0						
				2 cwts. dustage	—						
				24	£20 15 0		20	15	0		
				Batch total cost			£298	13	9		
				= per cwt.			67s. 1d.			ex Picking Dept.	

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The soaked peas increase in weight by about 90% to 100%, and because of this the cost of the total weight of the dried peas used, at the appropriate cost, is divided by the yield of processed peas in cans for each cost period. This gives a "contents cost per can". To this cost of prime materials are added the other canning costs which have been fully detailed in Chapter V concerning the canning of fruits and vegetables in general. With the exception of the special procedure outlined above the remaining items in the Cost Summary on page 34 follow the same lines.

B. Canned Beans.—Beans may be canned in a variety of ways, including (a) boiled, with sauce; (b) baked with tomato sauce; (c) baked, with tomato sauce and pork and (d) curried. Boiled beans are mainly the larger kinds of beans, and the baked beans productions are the smaller varieties.

The preparatory operations before passing to the canning line are :

- (a) Screening to remove impurities.
 - (b) Sorting into uniform sizes.
 - (c) Soaking.
 - (d) Cooking by boiling or baking.
 - (e) The manufacture of meat sauce, tomato sauce or curry.
- These are made in batches.

On transference of the prepared ingredients to the Filling Line, the first operation being the filling mechanically of cans with beans, sauce and pork. The cans are then capped and travel to the sterilising retorts by conveyors. After appropriate heat sterilisation the cans are stacked and in due course labelled and packed into cases or cartons.

Method of Costing.—The use of process costing is appropriate, or Unit or Single Output Costing can be used by the application of ratios for types and sizes.

Procedure for Costing.—*Materials.* The beans are received into store in sacks. Each grade is kept separate, and receipts and issues are recorded accordingly. Goods Received Notes and Issue Requisitions are used. Screening and sorting daily records are made of the weights.

In the department preparing the sauces in accordance with recipe or specifications, daily records are maintained of the batches of each kind made. The cost of pork, when used, will be based on the prepared cost, as shown by the "Meat Preparation Account", of which an example is illustrated on page 118.

The cooked beans and sauce, issued in batches, are the subject of production notes which enable the cost accountant to make the proper debits to the Canning Cost Account, from which a Cost Sheet is prepared for each four-weekly cost period. The number of cans filled from each batch is recorded to determine the yield.

The ingredients cost per dozen or per 100 cans is thereby ascertained.

Direct Labour should be sectionalised for each process involved. The sequence is as follows :

- (a) Unloading and storing.
- (b) Screening.
- (c) Sorting.
- (d) Soaking.
- (e) Baking (or boiling) and delivery to Filling Room.
- (f) Preparation of sauce and delivery to Filling Room.
- (g) Preparation of pork and delivery to Filling Room.
- (h) Filling and capping.
- (i) Sterilising.
- (j) Trucking.
- (k) Stacking.
- (l) Labelling (or finishing).
- (m) Packing into cases, and sealing cases.

Indirect Labour is charged as a general percentage on direct wages in each department.

Items (a) to (e) will give the labour cost per "x" lbs. of beans, and from the known weight of beans per can a labour cost per dozen cans can be calculated. Items (f) to (m) will cover the handling of "x" no. of cans, to give in turn the labour cost per dozen cans for these sections. The varying sizes of cans are brought to a common unit for the purpose of cost apportionment.

Factory Overhead Expenses. These are apportioned individually to departments of the cannery, so that the total for bean canning may be correctly assessed. The Bean Canning Department expenses must be further divided into two sections, i.e.,

- (a) Bean preparation and cooking, sauce and meat preparation and cooking.
- (b) Filling, and processes to packing.

The special features concerning the methods available for determining the basis for recovering these overheads are described on page 32.

Cost Sheets.—In each four-weekly cost period a separate Cost Sheet should be prepared from the ascertained departmental costs. A separate Cost Sheet is required for each variety or type of finished product. In effect these Cost Sheets are summaries of the individual batch costs of all batches canned in each period. These costs are shown in three columns : total cost of each item ; batch cost ; and unit cost, which is usually 1 dozen or 1 gross.

A specimen Cost Summary for beans in tomato sauce, with pork, is given on page 196.

Summary Cost Sheet.

Canned Beans, in Tomato Sauce, with Pork.

Cost Summary.

Four weeks ending

Batches made

Size Cans

Total cans filled

Yield per batch

	Total Cost.			Batch Cost.			Per Dozen Cans.	
	£	s.	d.	£	s.	d.	s.	d.
Materials.								
Beans								
Pork, as per Preparation A/c .								
Sauce, do. do. .								
Labour.								
Preparation								
Filling								
Sterilising								
Packing								
Packages.								
Cans								
Labels								
Cases and sundries								
Factory Overheads								
Factory Cost								
Administrative Expenses%								
Warehouse Cost								
Selling and Distribution Expenses .								
Total Cost								

The above is compiled from the detailed Cost Sheets for each batch ; it may be arranged to incorporate the details, as for example in the one illustrated on page 34.

CHAPTER XXXII

THE LAUNDRY INDUSTRY

LAUNDRIES vary considerably in character and size. Some have been equipped to handle special kinds of work, such as that for large hotels, hospitals, public institutions, and military camps, but by far the greater number cater for a more varied local demand. The plant, machinery and facilities employed by the more advanced laundries are highly specialised, with corresponding division of labour.

In 1926 the most important trade association for the industry, the Institution of British Launderers, published a brochure describing a system of cost accounting for laundries, and it is unfortunate that more serious attention has not been given to it by the industry in general. It is probable that war-time requirements as regards prices have resulted in many launderers becoming more cost conscious.

The method of costing described in this chapter is a practical one, and not unduly complex. It affords a means of establishing reasonably reliable costs, and avoids the misguided practice, adopted by many in the industry, of relating expenses to turnover as a measure of weekly or monthly efficiency. In addition to the advantage of knowing the correct cost of laundering various domestic articles, the cost system provides the basis for determining the incidence on costs when bulk work is done for hotels, hospitals, schools, and other institutions. A very large number of laundries depend on such work for the maintenance of an economic level of production. It is undertaken almost exclusively under special contract terms, and whilst such work is often necessarily sought at lower prices to secure balanced production, it is important that costs at least should be covered, otherwise, instead of lowering the incidence of costs on ordinary work, the latter will be, in effect, subsidising the contract work.

Laundry Operations and Processing.—The operational procedure is, broadly speaking, common to all laundries. The articles to be washed, which have been collected or received from customers in bundles, boxes, hampers, etc., are carefully checked in the Sorting Room, and are marked individually for identification.

Marking. The most common procedure is to mark each article with a reference number allotted to the customer, using marking ink. The mark may be made by hand, by the use of a

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rubber stamp, or by a small machine. Some laundries use cotton labels, which are attached to the articles, and this method is used if the material is incapable of direct marking. Some advanced laundries stamp bold letters or figures with a fluorescent mark which is invisible except when the article is placed under a special lamp. The special marking machine and lamps are installed at convenient positions in the receiving room, and also in the room in which the finished work is re-assembled for return to customers.

Sorting. The first sorting, which takes place as the articles are checked in, is usually effected by dropping them into a series of bins, baskets or other receptacles—*e.g.*, separate ones for collars, socks, coloured cotton or wool, etc. A few laundries are equipped with a transporter belt, or series of three such moving bands, upon which the articles are placed after checking in. When three bands are used they carry respectively cotton, wool and silk articles to the room when they are prepared for washing. If a single belt is used, the articles are removed by sorters into appropriate bins. This sorting is necessary, as washing treatment varies according to the material of which each article consists.

Washing Machines. Woollens, silks and cottons are dealt with separately, and regard is paid to separation of coloured articles from white.

The articles are carefully and skilfully packed into a cylindrical container in the machine. This container is perforated and revolves horizontally in the water which flows intermittently through the machine. Soap or a chemical equivalent is used, until the final rinsing with water alone is introduced. Batteries of these machines are used in the larger laundries. The work is both heavy and skilled, and normally is done by men, and the operation is carefully timed according to the nature of the articles or materials being washed.

Hydro-Extractors. The articles are unloaded from the washing machines, and transferred to "hydro" machines, which, revolving on a vertical axis, extract the water by centrifugal force. This is called "rough drying".

Subsequent treatment depends on the nature of the articles and materials. For example, some may be passed through a further drier. Simple suspension in a drying room may be used, but more often, especially with heavier articles, these are clipped on to a moving rail which conveys them slowly through a suitably heated and ventilated chamber or drier unit. Other articles not requiring this second form of drying treatment are transferred to the steam presses of various types for particular work; to the calendars, which are steam heated and may be single-roller (Decoudin) or multi-roller pattern; or to the Hand Ironing Room. Some articles may be starched first. It may be observed

that the steam presses are built for special purposes, thus for shirts the unit consists of five separate parts to press sleeves, collar, etc. Also the calendars may be very wide, enormous machines (e.g., to take two bedsheets abreast) requiring teams of girls to feed the articles smoothly to the rollers, and another team to take from the machine at the opposite side; others may be smaller and lighter machines to handle smaller articles.

Packing. The finished articles are transported to the Packing Room. Here there are a large number of adjustable racks of shelves on to which the articles are sorted according to markings; or a series of tables or fixed bins may be used. Each customer's heap is checked, and suitably packed for despatch.

Delivery. The packed finished laundry hampers and parcels are transferred to the Despatch Room, where they are sorted by districts, depots, etc., corresponding to the delivery rounds. Large laundries maintain a considerable fleet of delivery vans, the operation of which necessitates careful organisation.

Method of Costing.—Process Costing is most suitable. The method of overall Unit Output Costing using the "per lb." unit is not sufficiently accurate. The use of process costing permits the adoption of cost units suitable to each operation or process, as will be described later.

Procedure for Costing.—*Wages.* Wage rates in the industry are the subject of Trade Board control, and during war-time have been subject to the regulations of the Essential Works Order. It is necessary to make a departmental analysis of wages. When there are transfers of workers from one machine or department, as is required at times, the use of Time Sheets becomes necessary, and a Wages Abstract has to be prepared, in order that the correct charge can be debited to the respective Process Accounts.

Materials. The usual methods of stores records and control are used, as described in *Cost Accounting and Costing Methods*, Chapters IV and V.

Services—namely, gas, water, electricity and steam—form important items of cost in laundries, and weekly meter readings should be recorded.

Plant and Machines. A Plant Register should be maintained showing date and cost of installation, additions, and the appropriate depreciation for each item of plant, in order that the correct charge can be ascertained for debiting to the departments concerned.

Departmental Throughput. In order that unit costs may be determined under various headings in the departments, daily records of throughput are required. For examples see page 202.

Four-Weekly Expenses Statement and Trading Account.

	Over the Period Dec. 14, 19...				Cumulative to date, 19...			
	Budget	Actual	Up	Down	Budget	Actual	Up	Down
WOMEN'S COSTS:								
1. Wages and Insurance (Production)	17	105						
2. Washing Materials	10	13						
3. Machine Fuels and Shortings	4	4						
4. Finishing Materials	4	1						
5. Marking and Packing Materials	1							
6. Repairs Dept. Materials	1							
7. Wages Stationery and Laundry Books	1							
8. Office Expenses	1							
9. Dry Cleaning Machine	1							
10. Dry Cleaning Spots	1							
11. Dyes and Chemicals	1							
12. Laundry Supplies	1							
13. Telephone	1							
14. Repaired Work, 1st Q.	1							
15. Cleaning Order	1							
16. Oil	1							
17. Wages	1							
18. Wages Finishing Materials	1							
19. Materials, 2d Q.	1							
20. Lighting	1							
21. Gas	1							
22. Fuel	1							
23. Laundry Wages	1							
24. Laundry Wages	1							
25. Laundry Wages	1							
26. Laundry Wages	1							
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[illegible]

Note.—a denotes expenditure will be actual per accounts.

will be estimated.

may be either actual per accounts or estimated.

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Department.	Records Required.
Sorting and Marking	Number of items sorted by kinds of each group (woollens, cottons, silks, etc.).
Washing	Weight in lbs., separately, of cottons, woollens, silks, etc.
Hydro	Ditto ditto
Drying Plant	Ditto ditto
Calendars	Number of articles of each type passed through.
Presses	Ditto ditto
Hand Ironing	Ditto ditto
Collar Finishing	Ditto ditto
Racking and Packing	Number of items.

It may be mentioned that many launderers have been satisfied to express costs as a "per lb." unit of cost for all departments for the purposes of general control. Such a measure of costs gives fallacious results, and the small amount of additional recording required to establish separate departmental unit costs is well worth while, particularly as costs so ascertained can be used in the preparation of three valuable statements :

(a) A weekly or 4-weekly statement of total profit and loss by comparison of total costs with the total income for the cost period.

(b) A weekly or four-weekly departmental statement of costs of the throughput for control purposes. This also reveals the effect of seasonal and other fluctuations.

(c) A statement of actual itemised costs of laundering each individual article. This statement is an ideal one for control, and for deciding policy, in that it reveals the profitable (or otherwise) lines.

Monthly Expenses Statement and Trading Account.—This shows actual or apportioned expenditure in comparison with budget figures for each item of expense, and to facilitate inspection of results columns for variations from budget are included, for the cost period concerned. The introduction of cumulative totals for the year to date provides useful information as to progress of the trading position. For effective comparison this statement should be for each of thirteen four-weekly periods. In order to ensure correct analysis, it is advisable to use a classification numbering of the account headings to correspond with those on the statement. For a large laundry a classification on the lines detailed in Chapter IX of *Cost Accounting and Costing Methods* will be found useful. An example of this statement is illustrated on pages 200 and 201.

Departmental Costs.—The production working and upkeep costs shown in the monthly expenses statement just described have to be analysed and apportioned to each of the production and service departments. This is necessary to establish (i) unit costs

for each process or operation ; (ii) article costs by the application of the unit costs.

The following list shows all the more usual processes, but it must be observed that the number of such processes through which an individual article passes will vary, and it is unlikely that any article will go through all the processes enumerated.

Laundry Processes or Departments.

1. *Collection from Customers and Depots.*
2. *Sorting* : grading the laundry bundle into types of article—woollens, cottons, silks, etc. Each class may be sub-graded suitably to unit washing procedure—*e.g.*, woollens into blankets, shirts, undergarments, coats, suitings, etc.
3. *Marking* : placing an identity upon each individual garment, irrespective of classification, so that the whole customer's bundle may be re-assembled after laundering.
4. *Washing Machines.*
5. "*Hydroing*" : rough drying by mechanical hydro-extractor to a stage ready for final finishing.
6. *Drying* : generally restricted to woollen articles which do not require pressing by iron or machine.
7. *Starching.*
8. *Multi-Roll Ironing* : by calendars, whether with single roller or with several rollers.
9. *Pressing* : special presses are in use for particular kinds of garments—*e.g.*, shirt units of five separate presses—but it is sufficient for costing purposes to group together as one department.
10. *Hand Ironing.*
11. *Collar Finishing.*
12. *Racking for Re-assembly of Bundles, and Packing.*
14. *Delivery.*

For costing purposes the Departmental Grouping and selection of costing units recommended is as follows :—

Department.	Unit of Cost Adopted.
1. Collection and Delivery	Per Article.
2. Washing and Hydroing	Per Factor Unit-lb.
3. Drying	Ditto
4. Starching	Per Article Starched.
5. Multi-Roll Ironing	Per Machine Unit.
6. Pressing	Ditto
7. Hand Ironing	Per Unit Article.
8. Collar Finishing	Per Collar.
9. Sorting and Packing	Per Article.

The definitions and explanation of the Cost Units adopted will be given later when the respective Departmental Costs are considered.

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Process and Service Departmental Costs.—These are dealt with in four groups :—

- 1. Power and Heat, consisting of steam, gas, and electricity.
- 2. Building charges, comprising electric light, rent, rates, insurance, repairs to buildings and depreciation.
- 3. Plant and Machinery : maintenance and repairs, depreciation, insurance, engineers' wages.
- 4. Management Expenses.

Power and Heat. The method of ascertainment of cost, and its allocation to the departments or processes concerned is illustrated below.

Power and Heat Charges Apportionment.

	Charge for 4-Weekly Period. £		Charge for 4-Weekly Period. £
(A) STEAM :		(B) GAS :	
Fuel, coal	70	Consumption per	
Stokers' wages	20	Monthly Trading Ac-	
Building charges per		count	5
allocation	7.25		
Plant charges per allo-		Cost per 1,000 cu. ft. = 54.0 pence.	
cation	58.00		
General charges per allo-		(C) ELECTRICITY :	
cation	20.88	Consumption per	
		Monthly Trading Ac-	
Total cost of steam		count	20
raising	176.13		
		Cost per Unit 0.50 pence.	
Total steam raised in lbs. 1,409,000			
Cost per 1,000 lbs. 30.000 pence.			

Allocation to Department (A) : Steam. 4-Weekly Period No.....

Department.	Steam Con- sumption per Hour.	Hours Run.	Steam Con- sumed, lbs.	Cost per 1,000 lbs.	£
Washing and Hydroing	4,000 lbs.	140	560,000	30.0d.	70.0
Drying Room	1,000	40	40,000	"	5.0
Multi Roll Ironing	2,600	160	420,000	"	52.5
Pressing	2,000	150	300,000	"	37.5
Hand Ironing	334	150	50,000	"	6.25
Collar Finishing	780	50	39,000	"	4.88
	10,714 lbs.	690	1,409,000	30.0d.	176.13
Similarly with Gas and Electricity according to consumption by meter reading, by estimate, or technical calculation.					

Further explanations as to the calculation of the cost of these services are given below.

Steam Costs. The allocation of steam costs depends on adequate records of steam consumption in each department. Where meters are not available the steam consumption per operating hour can generally be obtained from the machine manufacturers concerned, and in particular cases the Research Bureau of the British Launderers Research Association is in a position to advise. Once known, the "standard" rates of consumption can be retained until circumstances change.

The total amount of steam raised can be calculated by the use of a water meter (if necessary hired from the manufacturers) on the water inlet to the boiler; taking care to record all water entering the boiler from the feed tank, and returned hot water.

On the basis of 10 lbs. of steam per gallon of water recorded, the steam raised is known.

Alternatively, steam raising can be estimated from coal consumption records, and this method of obtaining approximate measure is common where other measurement is not possible. It is necessary to know the calorific value of the coal used, and to assess the boiler efficiency, generally 60–75%, depending on the type and age of the boiler. For example:—

Assumed Boiler Efficiency 70%.

Assumed Calorific Value of Coal 15,000 British Thermal Units.

$$\frac{15,000}{966} \times \frac{70}{100} = 10.87 \text{ lbs. steam per lb. coal.}$$

Then coal consumption in lbs. multiplied by 10.87 gives the total lbs. of steam raised.

Gas and Electricity. Generally consumption of gas and electricity does not present difficulty. The local power company, if consulted, can provide adequate "standards" of consumption per operating hour for the machinery involved. It is usually possible for the consumption to be measured or technically calculated.

Processing Costs of operating in each accounting period (monthly, quarterly, etc.) are shown in total by the Departmental Cost Summary and a series of production records and statistics are necessary before the departmental totals can be reduced to a cost per unit of work. These units of work necessarily vary in each department.

Washing and Hydro Department. The most common unit used in this department is probably the lb., but experience of many laundries has shown that this basis is unreliable. The period of time required for washing varies and falls broadly into three classes—e.g., silks, cottons, woollens. By applying factors (to represent the difference in time taken by the washing cycle for

Buildings Charges Apportionment.

	Charge for Year.	Charge for 4-Weekly Period.	Monthly Trading Account.
Electricity (lighting)	£ 65	£ 5	Item 19b
Rent, rates	130	10	„ 23
Insurance	130	10	„ 29a
Repairs to buildings, materials	650	50	„ 25a
Repairs to buildings, wages	260	20	„ 25b
Depreciation	520	40	„ 28
General expenses (buildings)	130	10	„ 22
Total buildings charges for year	1,885	145	

Department.	Area in sq. ft.	% of Total.	Charge to Depart- ment for Year.	Charge to Depart- ment for 4-Weekly Period.
Washing and Hydroing	500	10	£ 188-50	£ 14-50
Drying	250	5	94-25	7-25
Starching	150	3	56-55	4-35
Multi Roll Ironing	1,000	20	377-00	29-00
Pressing	500	10	188-50	14-50
Hand Ironing	250	5	94-25	7-25
Collar Finishing	100	2	37-70	2-90
Sorting and Packing	1,000	20	377-00	29-00
Collection and Delivery	1,000	20	377-00	29-00
Power and Heat *	250	5	94-25	7-25
	5,000	100	1,885-00	145-00

* Allocated later over Productive Consuming Departments.

Plant Charges Apportionment.

	Charge for Year.	Charge for 4-Weekly Period.	Monthly Trading Account.
	£	£	
Machinery and plant maintenance, materials	715	55	Item 24a
Machinery and plant maintenance, wages	260	20	„ 24b
Depreciation	520	40	„ 27
Plant insurance (say)	130	10	„ 29b
Engineers' wages	260	20	„ 21b
Total	1,885	145	

Department.	Value of Plant.	% of Total.	Charge to Depart- ment for Year.	Charge to Depart- ment for 4-Weekly Period.
	£		£	£
Washing and Hydroing	2,400	8	150.80	11.60
Drying	1,500	5	94.25	7.25
Starching	600	2	37.70	2.90
Multi Roll Ironing	7,500	25	471.25	36.25
Pressing	3,600	12	226.20	17.40
Hand Ironing	300	1	18.85	1.45
Collar Finishing	900	3	56.55	4.35
Sorting and Packing	1,200	4	75.40	5.80
Power and Steam *	12,000	40	754.00	58.00
	30,000	100	1,885.00	145.00

* Allocated later over Productive Consuming Departments.

General Charges Apportionment.

	Charge for Year.	Charge for 4-Weekly Period.	Monthly Trading Account.
	£	£	Item 7
Stationery, factory	130	10	„ 8
Collar replacements	13	1	„ 13
Telephones	78	6	„ 26
Repairs to utensils	130	10	„ 45
Advertising	130	10	„ 46
Bad debts	65	5	„ 47
Office salaries	910	70	„ 48
Management salaries	1,300	100	„ 49
General expenses	130	10	„ 50
Stationery (administration)	130	10	
Total	3,016	232	

Department.	Wages for Year.	% of Total.	Charge to Depart- ment for Year.	Charge to Depart- ment for 4-Weekly Period.
	£		£	£
Washing and Hydroing	229	8	241.28	18.56
Drying	28	1	30.16	2.32
Starching	28	1	30.16	2.32
Multi Roll Ironing	458	16	482.56	37.12
Pressing	143	5	150.80	11.60
Hand Ironing	14	0.5	15.08	1.16
Collar Finishing	14	0.5	15.08	1.16
Sorting and Packing	142	5	150.80	11.60
Collection and Delivery	1,560	54	1,628.64	125.28
Power and Heat *	260	9	271.44	20.88
	2,876	100	3,016.00	232.00

* Allocated later over Productive Consuming Departments.

each class of work), to the weight of work washed, a total of "Factor-lbs." washed is obtained, thus :

Type.	Weight Washed, lbs.	" Factor " lbs.	Time in Minutes of Washing Cycle.	Factor.
Silks . . .	1,438	2,876	20	2
Cottons . . .	5,000	15,000	30	3
Woollens . . .	33,000	165,000	50	5
	39,438	182,876	to Departmental Cost Summary, Col. 3.	

The above factors are examples only and may be extended as required.

Drying Department. The unit of work generally used for cost purposes is the lb. weight of articles dried, and for practical purposes it yields reasonably reliable results. If, however, greater accuracy is required the weight of work of each type may be adjusted by ratio factors to allow for thickness of material, and size. Such factors can be assessed by tests as to drying time required and the amount of handling involved. The use of drying rooms and cabinets, or of mechanical driers, is almost exclusively limited to woollen goods. The mechanical drier is a heated structure through which on a winding rail run a large number of pulleys holding the damp articles. Thus, if a blanket suspended on the pulleys is large and thick, it may need more than one passage through the drier. Tests applied to all articles laundered will determine the time and space required by each, and with this information the articles can be classified into "factor groups". For example, a woollen garment may occupy two pulley grips, and need to go twice through the circuit, and a factor 2.5 may apply—i.e., it would be rated on the basis of $2\frac{1}{2}$ times the standard 1 lb. unit, and bear the drying expense as if it weighed $2\frac{1}{2}$ times its actual weight.

Starching Department. The unit usually adopted is an article starched. The total cost of the department, divided by the number of articles starched in the period, gives an average unit starching cost, which, although not precise, owing to size and other variations, is sufficiently accurate for general purposes.

Multi-Roll "Ironing" Department. This is a department which is heavily used, and close control is necessary to ensure that varying costs of different sizes and weights are properly assessed. This is particularly necessary because contract work includes a very high proportion of "flat" work, such as sheets, table-cloths, etc., all of which are "finished" on these costly machines.

The number of articles of each kind processed is multiplied by the appropriate factor, and the total number of "Factor Articles" processed calculated. The total departmental cost divided by the number of Factor Articles processed gives the cost per Factor Article.

Pressing Department. The procedure in this department follows precisely that of the Multi Roll Ironing Department, and a separate table of Article Factors must be prepared before the throughput disclosed by analysis of articles pressed in the period can be expressed in terms of "Article Factors".

Hand Ironing Department. The articles ironed by hand in the modern laundry tend to become fewer, but nevertheless the method of establishing factors for each article ironed is necessary. The element of time taken to hand iron is easily determined by a series of tests. With the table of factors established, the calculation of the cost per Factor garment follows the method already described.

Collar Finishing. In this department the departmental cost is simply divided by the number of collars finished and a cost per collar calculated.

Collection and Delivery. The most consistent unit for expressing the cost of this service is per article passed through the laundry. It is sufficient, therefore, to divide the total departmental cost shown in the summary by the number of garments laundered in the period. Similarly with the *Sorting, Marking, and Packing Department*.

The Departmental Cost Summary on pages 212 and 213 shows the departmental totals divided by the appropriate production expressed in terms of cost units to disclose the cost per unit for the period concerned.

Summary of Costs for all Articles Laundered.—This is a detailed list of all articles for which the cost of laundering is required, and shows the cost involved for each process or operation through which it has passed. The portion of such a summary is illustrated on pages 214 and 215. This has been prepared to show the cost of a single article of each kind, which is a useful guide to the management when laundry prices are reviewed. If desired, a similar form can be used to show total costs for the period for all the articles laundered, and thereby secure reconciliation in totals with that of the Departmental Cost Summary on pages 212 and 213, but this is not usually required.

If a supply of forms is printed, incorporating all kinds of articles usually handled and unit values, in the manner indicated on page 210, clerical work in the Cost Office can be minimised, as only the columns headed "cost" then require to be entered.

Departmental Monthly

COST PERIOD NO. 13,

Notes.	Details.	Washing and Hydroing.		Drying.		Starching.		Multi Roll Ironing.	
		Budget.	Actual.	Budget.	Actual.	Budget.	Actual.	Budget.	Actual.
		£	£	£	£	£	£	£	£
(a)	Productive wages (including van and depot wages of collection and delivery)	30-00		5-40		1-50		14-00	
(b)	Materials	10-00							
(c)	Felts and sheetings							3-00	
(d)	Water, electricity and gas	18-00		3-00		0-50		4-00	
(e)	Power and steam	70-00		5-00				52-50	
(f)	Building charges	14-50		7-25		4-35		29-00	
(g)	Plant charges	11-60		7-25		2-90		36-25	
(h)	General charges	18-56		2-32		2-32		37-12	
(i)	Collection and delivery (excluding wages and salaries) and depots								
(j)	Dyeing and cleaning and sub-contract work, (incl. wages £21)								
		172-66		30-32		11-57		175-87	
	Throughput of work	182,876 factor-lbs.		7,276 factor-lbs.		2,776 articles.		10,308,000 factor-garments.	
	Cost per Unit-of-Cost	0-23d. per factor-lb.		1-00d. per factor-lb.		1-00d. per article.		0-004d. per factor-garment.	

Notes.—(a) From wages abstracts analysis. (b) and (c) From materials issued abstracts.
(A) Schedule, page 203. (i) Items 32 to 44, schedule, pages 200 and 201.

all Articles Laundered.

Hand Ironing.		Collar Finishing.		Sorting and Packing.		Total Production Cost.	Collection and Delivery. Wages, etc.		Total Cost.	Profit.	Selling Price.
0-002d.		0-250d.		0-100d.			0-510d.				
Unit Value.	Cost.	Unit Value.	Cost.	Unit Value.	Cost.	Pence.	Unit Value.	Cost.	Pence.	Pence.	Pence.
	d.		d.		d.	d.		d.	d.	d.	d.
				1	0-100	1-802	1	0-510	2-313		
				1	0-100	4-790	1	0-510	5-300		
				1	0-100	6-250	1	0-510	6-760		
				1	0-100	3-794	1	0-510	4-304		
				1	0-100	2-566	1	0-510	3-076		
				1	0-100	1-332	1	0-510	1-842		
				1	0-100	7-488	1	0-510	7-998		
				1	0-100	3-793	1	0-510	4-303		
				1	0-100	1-408	1	0-510	1-918		
3	0-006	1	0-250	1	0-100	1-657	1	0-510	2-167		
				1	0-100	1-336	1	0-510	1-846		
				1	0-100	5-055	1	0-510	5-565		

CHAPTER XXXIII

COMMERCIAL PRODUCTION OF ANTITOXINS AND SERA

THE use of sera and antitoxins by the medical profession, and particularly in hospitals, requires a considerable commercial production in this and other countries. The production is of a highly specialised and technical character, and is closely controlled at all stages by Government regulations and standards.

Sera and antitoxins are administered to human beings by injection, and their function is to give protection against such diseases as diphtheria, tetanus, scarlet fever, dysentery and gas-gangrene. Bacteria of certain diseases, during their process of development, produce a "toxin" or poison in soluble form. This toxin forms the basis of antitoxin production. It is prepared on a large scale in the laboratory, the bacteria being grown on culture media, under strict technical control. When, after testing, a suitable toxin is obtained, it is subsequently injected into horses at repeated intervals, thus producing in the bloodstream a substance described as "antitoxin", which neutralises the toxin. This antitoxin is obtained by taking quantities of blood from the horse, allowing this to clot, and then decanting the residual blood serum (known as antitoxic serum) which contains the antitoxin.

Throughout the above process, which is continuously under close veterinary supervision, small samples of blood are being taken for the purpose of testing for potency (or strength). It is the results of these tests that determine the time at which each horse shall be bled. Horses vary considerably in their antitoxin-producing capacity, and, where commercial production is concerned, this can be most economically achieved by bleeding the horse at such times as to give the maximum amount of antitoxin. It follows from this that the testing of samples is a very important factor in production.

After the antitoxic serum is obtained, it is subjected to a process of filtration, and is then concentrated and refined. This latter process removes certain protein matter without reducing the antitoxic value. In obtaining the purified concentrated antitoxin from the "natural" sera, considerable process losses are experienced. This process is subjected to close scientific control, and testing is carried out at all stages. Full process and testing

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records are kept in accordance with Government regulations. No antitoxin may be issued for use unless it conforms to searching final tests for potency, toxicity and sterility.

In its final form the product is issued in sealed glass ampoules, each containing sufficient for one injection or in multi-dose bottles containing sufficient for a number of injections. The information given on container labels must comply with special rules laid down by Government regulations.

The strength of antitoxic sera is measured by reference to a standard unit per c.c. The metric system is used for volume measurement; the volume expressed in c.c.'s, multiplied by the units per c.c., gives the total units present in a given quantity of antitoxic sera.

Method of Costing.—Unit or Output Costing can be used, but for closer costing Process Costing can be arranged. In the concentration stages the costing is on a batch basis.

The unit of cost depends on the serum or antitoxin concerned. It will correspond to the recognised medical standard, if there is one, and will be a cost per million units—*e.g.*, for diphtheria “Ehrlich Units”; for tetanus “International Units”. For some anti-bacterial sera there is no standard, and for these the costing unit is “per litre” produced.

The antitoxins are filled into ampoules or vials, and at this stage of production the unit costs of the packed product are ascertained “per vial” of a stated dose or number of units.

Procedure for Costing.—In order that the costs may be properly allocated, records are required to determine :—

(a) The cost of horse usage for each product after crediting any sum realised after subsequent sale of the horses or of carcasses.

(b) The cost of horse maintenance, separated into three categories—viz., (i) Full rations, (ii) Part rations, (iii) Grazing, with appropriate data for apportionment of the totals to products.

(c) The cost of small animals obtained by purchase or own breeding, and used for tests of various kinds. Actual usage of animals for testing is recorded in the laboratories in respect of particular products—i.e., toxin, toxoid, natural sera, concentrated antitoxin.

(d) The costs of labour, materials (including syringes, apparatus, etc.) and overheads appropriate to the test laboratories, for subsequent apportionment to particular products.

(e) The costs of toxin production, which includes testing.

(f) The costs of injection (or immunisation) and bleeding, including test bleeds.

(g) The costs of "drawing off" (or decanting), mixing batches of serum, testings for potency and filtration.

(h) The costs of concentration processes and final testing.

(i) The costs of filling into ampoules or vials, including testing of issued concentrated mixture to confirm label strength, and sterility tests.

(j) The costs of final packing of ampoules.

It should be observed that various records have to be maintained to conform with Therapeutic Substance Regulations—*e.g.*, usage of animals for laboratory tests, volumes of materials used and recovered, ampoules filled, etc.

Horse Usage Costs.—A Horse Register, on the lines of a plant register, is required. Each horse purchased is entered in the register (thus receiving a serial number), together with date and cost (see below). As and when a horse is allocated for

Horse Register (*Acquisition*).

Horse No.	Date Acquired.	Cost.	Allocation.		Remarks.
			Product.	Folio.	
1801	19..... Jan. 21	£ 50	D	21	
1802	"	55	"	"	
1803	"	—	—	—	
1804	"	50	T	32	
1805	"	58	—	—	
1806	"	48	—	—	
1807	Jan. 28	55	P	43	
1808	Feb. 9	50	N	54	
etc.					

Note.—Until allocated, the horses remain in this register. The product reference in the allocation column indicates which sera and antitoxin are concerned.

use on a particular product, this is indicated. Other columns show disposal details, price realised, and the loss chargeable to each product. Although these details can be incorporated in one register, it will be found convenient to open a separate section of the register for each product. This avoids analysis of the "loss" or usage debits. The procedure is illustrated by the register extracts on this page and page 220.

In practice it will be found convenient to transfer the quarterly totals of losses on disposal of horses or carcasses, as shown by the Horse Register (Usage), to a "Loss on Horses Account" indicating the Product. At the end of each year or half-year the accumulated loss chargeable is transferred to the

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respective production cost accounts for sera and antitoxins. It will be found more convenient if the horses remaining are carried forward to a new register sheet for the following period.

Horse Maintenance Costs.—Horses are maintained on full rations, part rations, and some may be turned out to grass during summer months, when production of certain products is suspended. It is necessary to adopt the following procedure :

(i) Keep daily records of all horses in these three categories, showing the respective totals for each product.

(ii) Analyse cost of fodder and other maintenance costs to ascertain the weekly, or daily, horse cost for the three categories.

Horse Register (*Usage*).

Section : *Diphtheria*.

Folio : 21.

Horse No.	Date.	Cost.	Date of Disposal.	Value Re-ceived.	Debits to Loss on Horses Account.			
					1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
		£		£	£	£	£	£
1798	10/1/...	52		2	50	—	—	—
1799	"	55		—	—	—	—	—
1801	21/1/...	50	28/2/...	5	45	—	—	—
1802	"	55	14/2/...	15	40	—	—	—
1821	6/4/...	52	21/4/...	5	—	47	—	—
1822	"	55	15/5/...	4	—	51	—	—
1823	"	"	6/9/...	2	—	—	53	—
etc.								

Note.—At each costing period the loss is totalled and debited to the " Loss on Horses Account ".

(iii) At the end of each costing period debit the total Horse Maintenance costs to the respective antitoxin and sera production accounts, in accordance with the horse-weeks applicable to each product.

In some periods there may be no production, and for this reason it is more satisfactory to use twelve-monthly periods for costing, or at least half-yearly periods, to avoid violent fluctuations.

The various items of fodder, medicines, dressings, brushes, utensils, etc., should be subject to the usual stores control procedure.

Overheads, both direct and apportionments, will require to be debited to the Horse Maintenance Account.

A specimen form summarising these maintenance costs, and comprising a summary of the horse-days applicable to each type of serum and antitoxin, is given on page 221.

Horse Maintenance Costs and Allocations.

Cost period :

							Horse-Days.	
							Type.	H-days.
	£	s.	d.	£	s.	d.		
Fodder, &c.							Diphtheria .	
.....							Tetanus .	
.....							Dysentery .	
.....								
.....								
.....								
Transport of Horses								
Sundry Materials, Stables								
.....								
.....								
.....								
Wages							* Total .	
Overheads								
Repairs								
Water, Light, Heat								
Rents, etc.								
Sundry Expenses								
Depreciation								
Total							Per horse-day s. d.	

	Debited folio.	£	s.	d.	Cost per Unit.*
Allocation.					
Dysentery					
Tetanus					
.....					
.....					
.....					
.....					
Total					

* Note.—The allocation, determined by multiplying the number of horse-days employed for each product by the cost per horse-day, may be divided by the number of million units (or litres as the case may be) to show the unit cost for this expense.

Small Animals for Tests.—Large numbers of small animals, especially mice, are used for various test purposes. Supplies of such animals are maintained by purchases from outside sources, or in larger undertakings by breeding and rearing. Even when purchased, test animals have to be carried in stock for varying periods before they are ready for issuing to the testing departments.

A *Small Animals Stock Account* is debited with all animals purchased, fodder, greens, labour and salaries, together with appropriate charges for overheads, including sundry equipment.

A *Laboratory Small Animals Account* is debited with issues to the test laboratory. A scale of charges based on previously ascertained costs provided by the Small Animals Stock Account is assessed, and the debits are made at these values. Should any profit or loss arise on the Small Animals Stock Account at the end of the year, it may be transferred to an adjustment account or direct to Laboratory Profit and Loss Account.

The actual usage of animals for testing is required to be recorded by official regulations and shown against the particular product—i.e., toxin, toxoid, natural sera or concentrates anti-toxin. This record affords a reliable basis for charging the relative costs to the respective products. Such charges include labour, supplies such as syringes, apparatus, etc., and appropriate overheads.

Toxin Production, including testing. Certain toxins are made throughout in the Media Department, while others are made in the laboratory from culture media supplied by the Media Department.

Since the Media Department produces media for other products and for sale, a separate departmental account should be opened. Media or toxins supplied for sera production are credited at cost and debited to the appropriate sera account.

Injection and Bleeding.—The costs of immunising injections and bleeding require apportionment, so that only the proper proportion of the costs is transferred to the debit of the various Antitoxins Accounts.

In arriving at the cost of toxin production, appropriate debits must be made for salaries of scientific staff, wages, glassware, laboratory supplies and overheads.

The production up to this stage is that of Natural Serum. The completion for each product is dealt with separately, and the quantity produced for each during the period, measured in terms of litres or million units divided into the total costs for the particular product concerned, provides the cost per litre or million units.

A **Natural Serum Stock Account** is maintained. This is necessary, as the serum is usually matured in store for prolonged periods before being subjected to subsequent concentration. There is usually a considerable variation in costs from period to period, as shown in the following example :—

Natural Serum Stock Account.

£		£	
To Production in period 1 :		By Issued for concentration :	
600 litres at 40s. .	1,200	250 litres at 40s. .	500
		„ Balance (350 litres) .	700
	<u>£1,200</u>		<u>£1,200</u>
To Balance (350 litres) .	700	By Issued for concentration :	
„ Production in period 2 :		650 litres at 49s. 3d. .	1,600
300 litres at 60s. .	900		
	<u>£1,600</u>		<u>£1,600</u>

Concentration and Mixing.—In due course concentration of the natural serum is undertaken. For this process a quantity or batch of the serum, consisting of various volumes of different potencies, is mixed and submitted for test for potency. The concentration process, of a chemical nature, results in reduced volume, but an increased unitage per c.c. Costs of filtration are also incurred.

The materials used and wages are recorded on batch charts, and batch costs are prepared. These batch costs will incorporate the apportioned overheads. Further potencies tests are made, and on the basis of these process losses are determined.

Residual material is recorded and carried forward for future processing.

The concentrated antitoxin is passed into stock until such time as issued for final mixing for filling into ampoules. It is necessary, therefore, to maintain a *Concentrated Antitoxin Stock Account*. As previously indicated, similar separate Stock Accounts are required for each product.

Mixing of Concentrate for Filling.—As standard issue strengths are laid down, it is necessary to determine by calculation what volumes of concentrated antitoxin at the different potencies stocked must be taken to produce a particular volume of final product issuable at a fixed unitage per c.c. In doing this, regard must be paid to certain other factors—i.e., chemical standards—so that the antitoxin, when issued, is suitable in all respects for injecting.

In costing this final production operation the costs must cover the inevitable loss of a certain amount of potency, which

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necessitates the provision of sufficient excess in unitage to compensate for such loss.

Final testing on the "Concentrated Mixture for Issue" is necessary to confirm the label strength or potency.

Sterility tests on the bulk material are also necessary before dispensing into ampoules or vials takes place.

The cost of these tests has to be taken into account, and may be based on a charge per test or as a direct apportionment of Test Laboratory Costs.

A Process Account on usual lines enables the unit cost per litre or per million units to be ascertained.

Filling into Ampoules or Vials.—In view of the costly nature of most antitoxins, care in the filling operations is important. The quantitative data necessary for costing the filling are provided by the Filling Department, and these must also be recorded in the laboratory to conform with the Therapeutic Substances Regulations, viz. :—

- (1) Volume of material used.
- (2) Volume of material recovered.
- (3) Potency (at label strength).
- (4) Number of ampoules or vials used.
- (5) Number of ampoules or vials broken or rejected.
- (6) Final yield.
- (7) Number of ampoules or vials passed to the Packing Department.

To ensure that the doctor will be able to take from an ampoule the full stated dose, it is necessary to add a small excess in volume, and this obviously affects the cost.

A Process Account for this operation incorporates the above data, and is debited with the cost of labour, supplies and departmental overhead. A separate column can be added to show the ampoule or vial cost.

Final Packing.—This follows normal lines of ampoule packing.

Losses of Filled Stock.—Sera and antitoxins carry a date of expiry within which they may be used, and cannot be sent out unless a proper period before expiry still remains. There is a loss in respect of any packed stock which becomes short-dated before sale. Records of such losses are kept, from which a percentage of total cost can be calculated for inclusion in the cost of filled ampoules. This charge can be conveniently included in the "Selling and Distribution Overheads".

Final Cost Summary.—Separate Cost Sheets are prepared for each process for the various sera and antitoxins. As indicated in the preceding descriptions, there is seldom the possibility of

continuous treatment through all the processes for a particular product. Owing to the peculiar circumstances of production, it is desirable to determine the unit cost of each serum or antitoxin based on a period of twelve months' production. For this purpose a composite Cost Summary may be prepared on the lines of the form given on page 226.

CHAPTER XXXIV

WAR-TIME COSTING OF CONTRACTS

1. In many Government contracts, both in Great Britain and the United States, there is provision for costing to determine the final price to be paid for the supply. In the United States a Treasury Decision (No. 5000) was promulgated under Section 2 (b) of the Act of June 28th, 1940, and other provisions (commonly called the Vinson-Trammell Act), by which regulations were made for determining allowable items of cost. These provisions are summarised in the following paragraphs, and although these relate specifically to the determination of costs under U.S.A. Government contracts it will be apparent that they enunciate principles which appear reasonable in relation to costing for any Government costed contracts. As might be expected there are minor variations in details in Great Britain and other countries, due to Governmental decisions on specific points of admissibility as to certain items of overheads of doubtful incidence.

2. **Components of Total Cost** are grouped under the following headings, although there is no requirement that contractors should adopt these in their accounts :—

A. MANUFACTURING COSTS

(i) Direct Shop Costs :

- (a) Material and parts.
- (b) Direct labour.
- (c) Shop engineering expense (chiefly salaries of engineers, technicians, draughtsmen, their works offices expenses, fixed charges and maintenance of plant).
- (d) Other Direct Shop Costs (detailed *infra*).

(ii) Indirect Shop Costs :

- (a) Supplies and sundry materials.
- (b) Indirect labour.
- (c) Services and maintenance.
- (d) Fixed charges.
- (e) Other indirect shop costs.

(iii) Other Manufacturing Costs :

- (a) Amortisation of patents, purchasing designs, etc.
- (b) Engineering and development expenses.

B. OTHER CONTRACT PERFORMANCE COSTS

- (iv) Delivery Costs.
- (v) Installation and Servicing Costs.
- (vi) Sundry Specific Contract Costs.

C. ADMINISTRATION AND DISTRIBUTION EXPENSES

- (vii) General Corporate and Administration Expenses.
- (viii) Tendering, Selling and Distribution Expenses.

3. Methods of Accounting.—There is no interference with the system or methods of accounting used by contractors, providing generally accepted and sound practices are followed; accordingly there is no attempt to prescribe a uniform system of accounts.

In an official pamphlet emphasis is laid on the importance of there being Ledger Control Accounts to ensure the reconciliation of the detailed Cost Accounts with the general financial accounts. Cost Accounts separately kept without such control are seriously open to question.

The use of Standard Costs as a means of managerial control is prevalent in the United States, and these are accepted for cost determination under Government contracts, if the variations from actual costs are properly adjusted to ensure that the final result represents actual cost.

4. Definitions and Observations on the components of total cost summarised in paragraph 2 above provide interesting comparison with practices in this country, and although the definitions are very similar in general to those used by British cost accountants they are summarised briefly in the following paragraphs.

5. Materials and Parts include all materials and fabricated parts entering directly into the product or into the fabricating, converting, or processing such materials or parts. The following points on charging to contracts should be noticed :—

(a) Actual prices of purchases made specifically for the contract should be used.

(b) Items taken from Stock should be charged at cost under any recognised method consistently followed. Methods accepted are : (i) First-in, first-out; (ii) last-in, first-out; (iii) average cost; (iv) standard cost (subject to the requirement referred to in paragraph 3 above); (v) specific purchase prices. (Method (ii) is very unusual. The writer has not met with it in this country.)

(c) Prices to be net—i.e., after crediting :—cash discounts in excess of 1 per cent.; all cash discounts accruing to prime

contractors on sub-contracts; trade discounts; rebates; allowances received or receivable; commissions; refunds; bonuses, etc.

(d) Excess materials retained, and scrap at current scrap prices (whether sold or not) to be credited.

(e) Carriage inwards is a proper addition to material costs. If not so treated, the basis of apportionment must be equitable.

(f) When a "direct" material is treated as an "indirect" material, the basis of allocation of the latter charge must be equitable.

6. Direct Labour wages is the charge for labour performed on and directly chargeable to the product, at actual cost. Points of interest are :—

(a) Special premiums, bonuses, overtime payments regarded as direct labour costs should be separately stated.

(b) Items in (a) are not to be included in the base for distribution of overheads when direct labour cost is the basis for apportioning overheads.

(c) There may be included under Direct Labour such costs as compensation insurance, old age benefit and social security taxes pertaining to the employment (corresponding to the British workmen's compensation and National Insurance payments by employers).

(d) Some contracts contain an "escalator" (wage variation) clause providing for adjustment of maximum or fixed prices named in the contract according to changes in labour rates. The labour subject to such adjustments is usually defined in advance, and normally will be stated in the contract.

(e) There is not complete uniformity of practice as to what labour is direct, even within particular industries, but providing the method of charging is in accordance with the contractor's regular procedure and is sound accounting, this is accepted.

7. Shop Engineering Expense.—The chief items have been named in paragraph 2 (i) c. In addition there are :—

(a) Engineering department supervision, clerical aid, stationery, drawing-office supplies.

(b) Drawing-office salaries for preparation of designs, blue prints, specifications and the study and improvement of shop and product methods and procedures. But these must relate directly to immediate operations as distinct from research, future development, new products and other products in concurrent production.

(c) Laboratories for analysis or testing do not come under this heading, but under Indirect Shop Expenses.

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8. Other Direct Shop Costs, which are not charged under the above-named headings of direct cost, but which, because they are associated with specific operations or products, should be treated as direct charges. Examples are :—

(a) Manufacturing royalties or licence fees (royalties to officers or employees are normally inadmissible).

(b) Amortisation or writing down of the initial cost of dies, patterns, and special tools, equitably apportioned having regard to the estimated period of useful life.

(c) Additional writing off of the cost of machines and plant due to accelerated usage or expenditure on special arrangement of facilities. This special charge should be shown separately from normal depreciation, which is included under Indirect Shop Costs.

9. Indirect Shop Costs.

(a) *Supplies and Materials not Charged as Direct*—e.g., fuel, lubricants, heat treating, plating, cleaning and anodising supplies, gauges, factory office supplies, small consumable tools (bits, chisels, drills, axes, templates, threading dies, etc.).

(b) *Indirect Labour*. Wages of foremen, assistants, inspectors, machine setters, cleaners, general labourers, oilers, time-keepers, shop clerks, crane operators, storesmen, factory office, laboratories, etc. Excluded from this heading is research and development labour, which appears under "Other Manufacturing Costs" as mentioned in paragraph 11 (b) below.

(c) *Service and Maintenance*—e.g., power, heat, light, water, gas, compressed air, ventilation, air conditioning, maintenance of plant, etc.

(d) *Fixed Charges* for recurring expenses, such as : insurance of assets ; property and plant taxes ; rents ; depreciation and obsolescence and depletion of natural resources on a unit basis over estimated life.

Not admissible are amortisation of unrealised appreciation of asset values, or of excess (i.e., idle) facilities. Costs of supplies may not include depreciation of facilities provided under Emergency Plant Facilities Contracts or Defence Plant Corporation Contracts, as this is not a charge borne by manufacture.

10. Other Indirect Shop Costs such as ordinary and normal rearrangement of facilities within a factory ; welfare ; holiday pay ; compensation insurance ; National Insurance not included elsewhere ; pensions, and depreciation of small tools, etc., not practicably chargeable as direct shop cost.

11. Other Manufacturing Costs.

(a) Cost of obtaining patents, designs, etc., amortised over the period of useful life.

(b) Development expenses—*i.e.*, research, experimental and development costs not related to current manufacture, but to future improvement in and application of products. They are admissible. When these expenses are deferred or capitalised in conformity with a consistent plan, a reasonable uniform allocation to cost is allowed. Instead of such uniform absorption rates, when such expenditure is written off as incurred each year a reasonable proportion may be included in costs.

12. Other Contract Performance Costs—*i.e.*, which are specific to a contract :

(a) *Delivery*—actual outward delivery charges paid, or a proper and equitable proportion of own transport costs.

(b) *Installation and Servicing Costs*. When contractor is required under a contract to install, erect, test, or assemble ; or to service ordinary adjustments or minor defects after delivery, these are a proper charge.

(c) *Sundry Specific Contract Costs* necessarily incurred to complete a contract, such as premiums on performance or other bonds ; purchase tax ; test expenses ; special travelling, to the extent not charged elsewhere or chargeable to other work.

13. Administration and Distribution Expenses :

(a) Salaries of executives and staff, subject to limitations named in paragraph 15 below.

(b) Office expenses, including staff welfare.

(c) Contributions to local charitable organisations to the extent constituting ordinary and necessary business expense, and dues or subscriptions to trade associations as distinct from donations.

(d) State and local taxes (but not income tax).

14. Bidding (Tendering) and Selling Expenses.—Cost of preparing, submitting bids or of negotiations upon estimated costs ; any selling and distribution costs properly incidental to and necessary for the performance of the contract.

Inadmissible as a general rule are :—

(a) *Selling expenses* ordinarily recognised for distribution through usual trade and business channels and methods. These are not necessary for doing business with the Government. For similar reasons Bad Debts and Debt Collection expenses are inadmissible.

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(b) *Commissions* paid by contractors. "It is manifestly improper for the Government to recognise as a legitimate cost a commission paid for obtaining business from itself."

(c) *Selling and Sales Offices* and agencies in various areas which are purely a commercial selling expense.

(d) *Advertising* is an inadmissible item of cost except advertising in trade and technical journals of value for dissemination of information for the industry.

In the case of sub-contractors there may be reasons for some relaxation of the limitations on selling and advertising.

LIMITATIONS ON ADMISSIBLE COSTS

15. Remuneration of Individuals may be limited when circumstances warrant, e.g. :

(a) Total remuneration, however described, in excess of \$25,000 per annum to an individual.

(b) Disproportionate or unreasonable increases since June 30th, 1940.

(c) When bonuses or fees are paid as a percentage of profits.

(d) When royalties are paid to officers or employees. As a rule they are inadmissible as cost.

16. Defective Work above normal for the type of production, or due to negligence and which could have been avoided by reasonable care and diligence, may be disallowed in total or in part. Due recognition is given for Government demands for abnormally rapid production.

17. Items Inadmissible to Costs.—Among items not admissible to the cost of performing a Government contract are the following :

(a) Interest on borrowed capital, however represented.

(b) Commissions, bonuses and special premiums under whatever name paid in connection with negotiations for or procurement of a Government contract.

(c) Entertainment expenses.

(d) Subscriptions other than regular trade associations.

(e) Donations other than those stated in paragraph 13 (c) above.

(f) Losses on other contracts.

(g) Losses from sales or exchanges of capital assets.

(h) Extraordinary expenses arising from strikes or lock-outs.

(i) Fines and penalties.

(j) Amortisation of unrealised appreciation of asset values.

(*k*) Expenses, maintenance and depreciation of excess facilities other than reasonable stand-by facilities.

(*l*) Reserves for contingencies, repairs and compensation insurance.

(*m*) Income and Excess Profits taxes.

(*n*) Bond discounts or finance charges.

(*o*) Premiums for life assurance on lives of officers.

(*p*) Special legal and accounting fees incurred in connection with reorganisations, security issues, capital stock issues, patent infringement or antitrust litigation, and the prosecution of claims of any kind (including income-tax matters) against the United States.

(*q*) Taxes and expenses on issues and transfers of capital stock and bonds.

(*r*) Losses on investments.

(*s*) Bad debts and reserves therefor; also expenses of collection and exchange.

(*t*) In general, commercial advertising and selling expenses, and especially advertising of a "goodwill" nature.

These exclusions follow the practice in this country fairly closely.

18. The Basis of Apportionment of Items of Cost.—No general rules are prescribed, it being recognised that the basis of charging expenses and other costs is dependent on the conditions and the nature of the operations in each individual case. The only condition is that the method used shall be in accordance with sound and equitable accounting practice. A number of the methods described in *Cost Accounting and Costing Methods*, Chapters XI and XII, are referred to as examples of acceptable methods for the apportionment of expenses of contracting manufacturers.

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